G-CEM.
The new direction in cement

TECHNICAL
INFORMATION

>> INTRODUCTION

The last 10 years have seen changes in the type of indirect restorations being placed by dental clinicians and specialist prosthodontists. The most significant trends have been the increase in implant dentistry, in particular single tooth implants, and the increasing use of all-ceramic crowns as an alternative to porcelain-fused-to-metal. Within the Oceania market approximately 30% of indirect restorations produced, whether laboratory or in-surgery fabricated, are now all ceramic.

This changing market has ensured a growing demand for a cement that offers:
- the convenience and consistency of capsulated delivery,
- the simplicity of one step cementation,
- the flexibility to be effective across of a wide range of applications,
- the aesthetics required for all ceramic restorations, and
- the added long term protection of significant fluoride release.

GC Fuji PLUS is a resin reinforced glass ionomer cement and it remains the market leader and benchmark for luting of metal and porcelain-fused-to-metal indirect restorations including crowns, bridges and posts. The market preference for GC Fuji PLUS is driven by its smooth consistency, simplicity of application, snap set, predictable performance, significant fluoride release and ideal capsule quantity and delivery.

While GC Fuji PLUS is suitable for luting of high strength ceramic crowns there is a growing need for an innovative solution for cementation of all-ceramic crowns, inlays and onlays that utilise aesthetic ceramics of under 600MPa flexural strength, eg Press ceramics (Empress II) and in-surgery milled ceramics (Cerec).

G-CEM is the culmination of GC Research and Development team's drive to develop a new generation of universal self etch cement that brings closer together glass ionomer and self etch resin technologies so that benefits of both can be universally applied to cementation procedures either in conjunction with GC Fuji PLUS or as a stand alone universal self-etch luting cement.

INNOVATIVE chemistry.
So SIMPLE to use.

Cementation indications	G-CEM Self-adhesive luting cement	Fuji PLUS Resin reinforced glass ionomer cement	FujiCEM Resin reinforced glass ionomer cement	Fuji I Conventional glass ionomer cement
Metal, PFM				
- Inlays, Onlays	Y	Y	Y	Y
- Crowns	Y	Y	Y	Y
- Bridges	Y	Y	Y	Y
- Endodontic Posts	Y	Y	Y	Y
Ceramics (less than 600 MPa flexural strength)				
- Inlays, Onlays	Y	Y	Y	
- Crowns	Y			
- Bridges	Y			
- Veneers				
High Strength Ceramics (greater than 600 MPa flexural strength)				
- Crowns	Y	Y	Y	Y
- Bridges	Y	Y	Y	Y
- Endodontic Posts	Y	Y	Y	

> G-CEM: The new direction in universal self adhesive luting cement

G-CEM's advanced formulation offers:

Simplicity – an easy to use, smooth seating cement with the simplest clean up of excess

No sensitivity – the unique hybrid glass ionomer/resin technology creates a predictable seal to all tooth surfaces dealing effectively with varying degrees of surface dryness

High protection – higher fluoride release than any other self-adhesive resin cement

Strong adhesion – to a wide range of surfaces through chemical and micromechanical bonding that rapidly matures so that high adhesive strengths are reached quickly

Fast setting – strong dual cure chemistry means a no-compromise result whether light cured or left to chemical cure

Colour stability – low water uptake and reduced chance of stain uptake

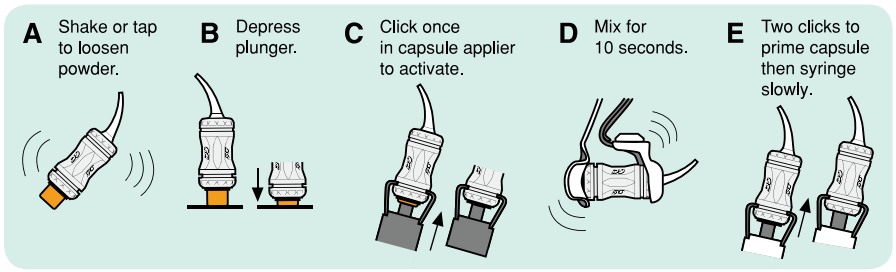
Durability and dimensional stability – no HEMA and lower expansion than any other self-etch resin cement

G-CEM Shades

AO3 A2 Translucent BO1

> G-CEM application technique: Unmatched clinical simplicity

Remove temporary cement, clean and dry



Activate and mix G-CEM capsule for 10 seconds

Apply to the internal surface of the crown and seat in the mouth

Light cure for 2-4 seconds until the cement has reached a gel phase

The excess cement is then easily removed using a scaler tip

The final restoration in place

> G-CEM application technique: Unmatched clinical simplicity

Q What are G-CEM's indications for use?
A Cementation of all types of all ceramic, resin and metal-based inlays, onlays, crowns and bridges. Cementation of metal, ceramic and fiber posts.

Q Prior to application of G-CEM how dry should the tooth be?
A Laboratory testing of adhesive strengths identified no significant difference in adhesion whether the tooth was dry or moist. We expect the best result will be achieved if excess moisture has been removed by air drying with oil-free air.

Q To activate GC capsules do I still need to depress the plunger and click once in the GC applier before mixing?
A Yes.

Q What mixing time do we recommend?
A 10 seconds (4,000rpm mixer) or 6-8 seconds (>4,500rpm mixer) or 5 seconds (rotational mixer). If mixing in a rotational mixer do not use the centrifuge option as this will increase the level of porosity in the mixed cement.

Q How much material is in a G-CEM capsule?
A 0.17ml, which in most cases is sufficient cement for several indirect restorations.

Q How much working time do you have with G-CEM?
A Approximately two minutes 15 seconds at normal room temperature. Higher temperatures will shorten the working time.

Q How can I extend the working time?
A Refrigeration (2-5°C) will increase the working time up to three minutes.

Q Will my operating light affect the working time of G-CEM?
A Yes, potentially it could so we would suggest you diminish the intensity or turn off your overhead light during the cementation procedure.

Q After seating the crown how much pressure should I maintain?
A Moderate pressure.

Q How long after seating is it possible to remove excess?
A The best results are achieved by light curing G-CEM excess for two to four seconds immediately following seating of the crown. Use a scaler and while maintaining pressure, remove the excess. Alternatively the cement can be left to self cure for approx 40-60 seconds after seating of the restoration and excess removed when the cement is at the gel phase.

Q When can I finish the margins?
A For self cure restorations (eg PFM) four minutes after seating of the restoration. For dual cure restorations (eg all ceramic crowns) immediately following 20 seconds light cure.

Q Which restorations should I allow G-CEM to set by self cure mode?
A Metal, porcelain fused to metal restorations. Dark and/or opaque ceramic restorations or ceramics which are greater than 2mm in thickness.

Q What has happened if I see a white mark on soft tissue when I remove the G-CEM excess?
A On rare occasions the self-etching action of G-CEM can cause a whitening effect on soft tissue. This is a temporary symptom which usually disappears within a short period of time (depending on the individual).

INNOVATIVE chemistry.
So SIMPLE to use.

> G-CEM:
Unmatched innovation

G-CEM chemistry:

G-CEM powder is fluoro-alumino-silicate glass from the same family of glass filler used in glass ionomer cements. The glass filler has a mean particle size of 4 micron and represents 71.4% filler loading by weight in G-CEM.

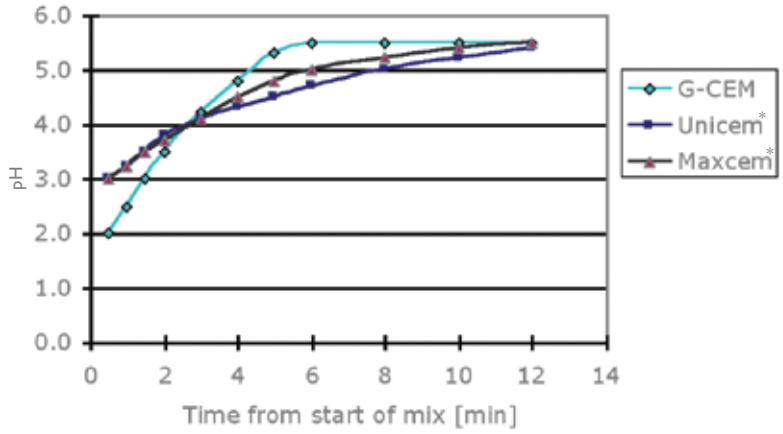
G-CEM liquid contains strong frame-forming resins, UDMA and Dimethacrylate, as well as acidic resins; 4-MET and phosphoric acid ester monomer. The acidic resins react with dentine, enamel and restorative material surfaces to form strong, durable bonded interfaces. Adhesion to tooth structure can be described as a combination of chemical and micromechanical adhesion.

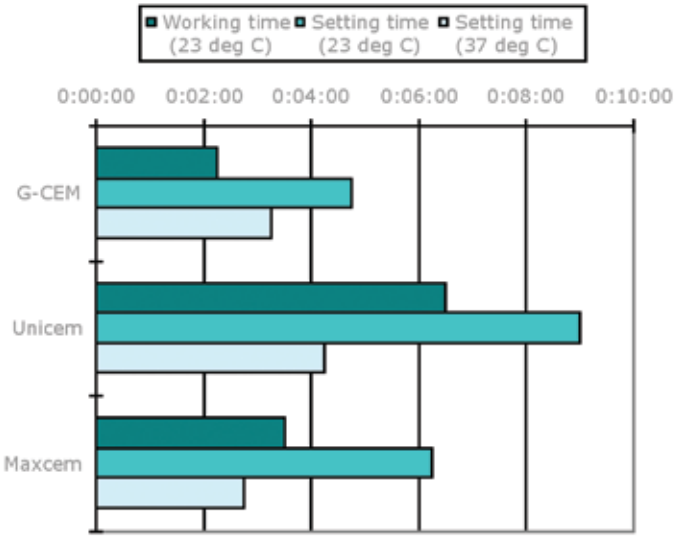
The other essential ingredient in the G-CEM liquid is a small amount of water. Previous technology in universal cement systems had relied on water within the tooth to facilitate post placement acid-base reactions. G-CEM technology incorporates water so that when mixed with G-CEM powder the acidic resins react with glass ionomer fillers to form a hydrated silica gel phase around the glass particles. This helps strengthen the cement matrix and allows for significant levels of fluoride release. This reaction is in addition to the chemical and light curing resin reactions.

The strength of this reaction and the speed at which it is undertaken is characterised by the following charts which map pH changes over time and the effect that has on working and self cure setting times. The new hybrid glass ionomer/resin chemistry of G-CEM is designed so that there is no compromise in adhesion or other physical properties should G-CEM be left to self cure or if it is light cured.

The addition of water in G-CEM is also helpful because variable tooth surfaces can compromise adhesion and lead to post placement sensitivity. G-CEM's formulation is designed to effectively penetrate smear layers and remove the variability of different moisture levels so that it can consistently achieve strong chemical and micromechanical adhesion to tooth surfaces.

pH change of mixed cement





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Q Is G-CEM defined as a resin cement or a glass ionomer cement?

A Glass ionomer cements are based on a glass polyalkenoate cement structure however instead of polyalkenoate acid and water G-CEM utilises acidic monomers (4-MET and Phosphoric acid ester) and water as part of the matrix forming reaction. While clearly not a glass ionomer cement G-CEM's water content and acid base reaction is not typical of a resin cement either. At present we have chosen to describe G-CEM as a self adhesive luting cement with characteristics of both resin and glass ionomer cement technologies.

Q How much water is there in G-CEM?

A In the mixed cement the water content is approximately 3%.

Q Where does the water go after it has set?

A Some water is consumed during the self-etching procedure. Remaining water is bound within the cement as part of the reaction zone (silica gel phase) surrounding each fluoro-alumino-silicate glass filler. The silica gel phase is a storage zone for fluoride ions which then become available for release in quantities not previously possible from a cement of this type.

Q Does G-CEM contain HEMA?

A G-CEM contains no HEMA. While HEMA is useful as a solvent for water based resin adhesive systems, it does allow hygroscopic expansion that could cause internal stress for cements with a higher modulus of elasticity.

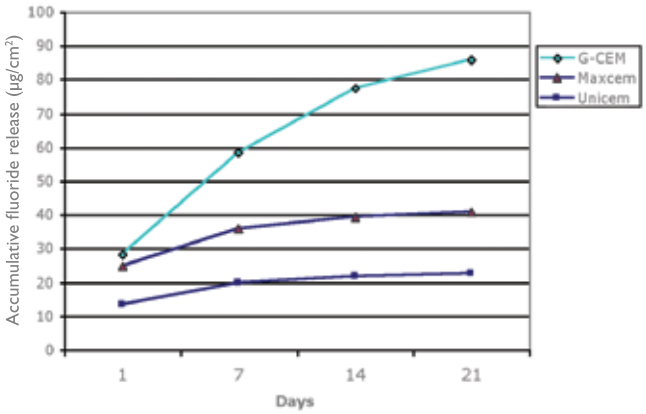
Q What does the new chemistry of G-CEM mean in terms of expansion?

A G-CEM formulation has less expansion than previous technology cements.

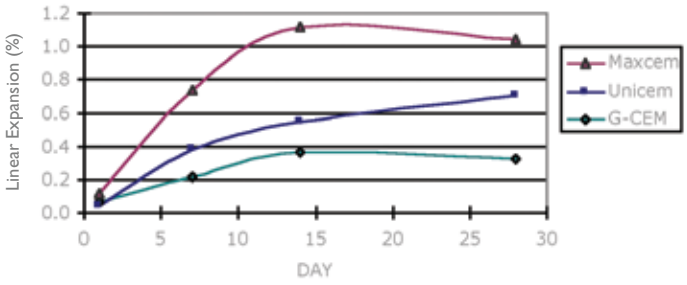
Q Is G-CEM more resistant to discolouration?

A Yes. This is detailed on right – confirmed through testing samples of different cements which were left to self cure. This is evidence of the high degree of monomer conversion during polymerization and the formation of a more stable and stain resistant cement structure.

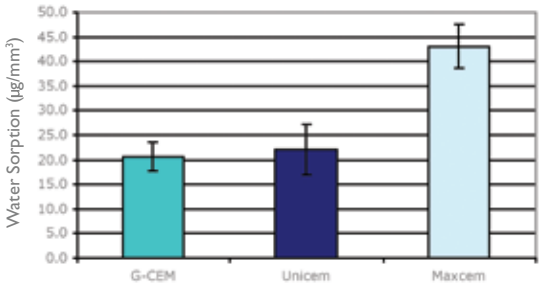
Cumulative Fluoride release



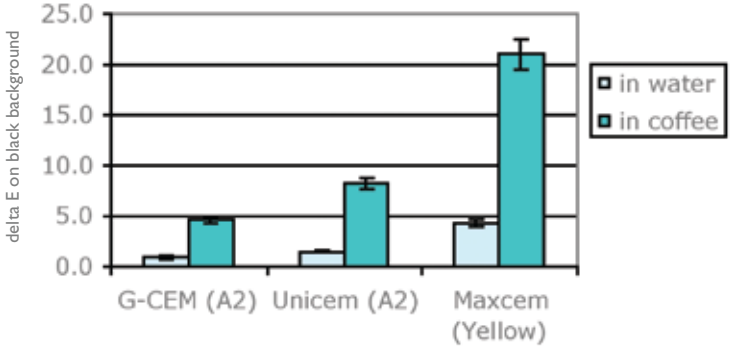
Linear expansion



Water Sorption



Discolouration in various liquids

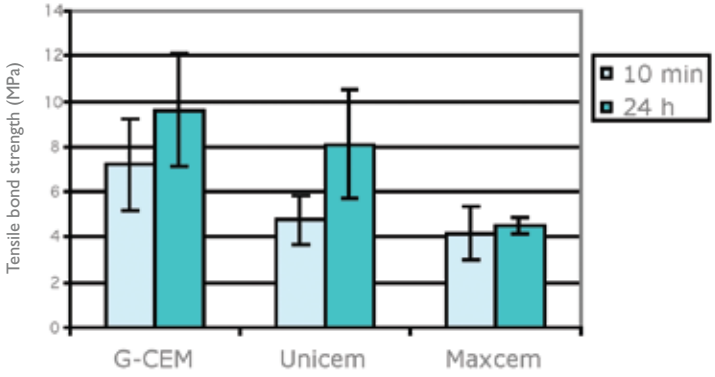


> G-CEM adhesion to dentine and enamel

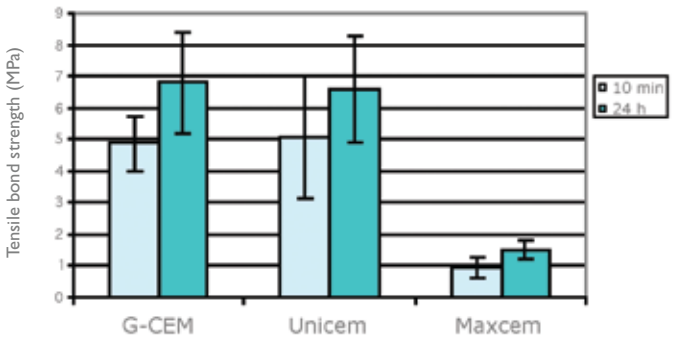
G-CEM field evaluations have uniformly reported strong adhesion and a lack of post cementation sensitivity. These are critical issues for successful placement of indirect restorations. G-CEM utilises two self etch adhesive monomers, 4-MET and phosphoric ester, which have a long history of stable chemical adhesion to dentine and enamel. The addition of a small amount of water within the G-CEM formulation means reasonable variations in moisture on the tooth surface will not interfere with the G-CEM setting reaction or its strong chemical adhesion.

Adhesion via self cure mode is important for most indirect cementation situations. The following testing looks at tensile bond strengths to enamel and dentine both short term (10min) and after 24 hour maturation.

Tensile Bond Strength to Enamel (self cure)

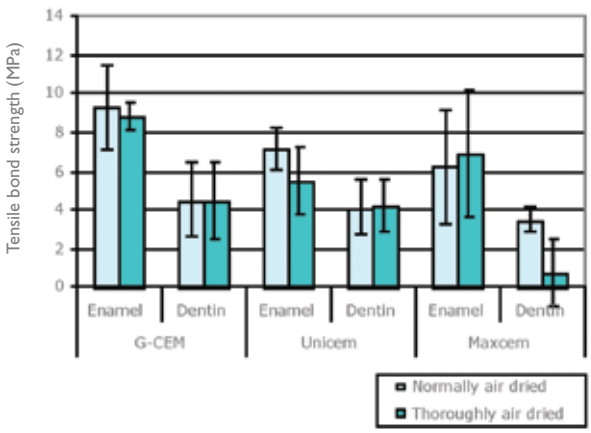


Tensile Bond Strength to Dentine (self cure)



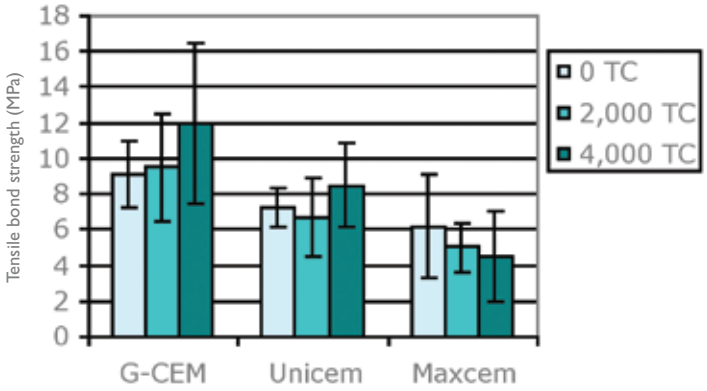
The effect of variations in moisture is important when considering the potential for differences in drying techniques practiced by dentists. G-CEM is consistent with its adhesion when tested using different drying techniques in self cure mode. This is due to incorporation of water within the cement reaction.

Effect of air drying on bond strength



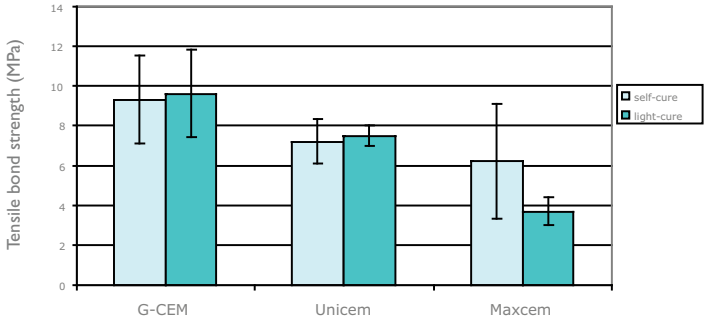
Thermocycling is one technique used to accelerate the results of stress put on a dental material as a predictor of the impact of aging within the oral environment. G-CEM in self cure mode shows resistance to degradation.

Effect of thermocycling on Bond Strength to Enamel (self cure)



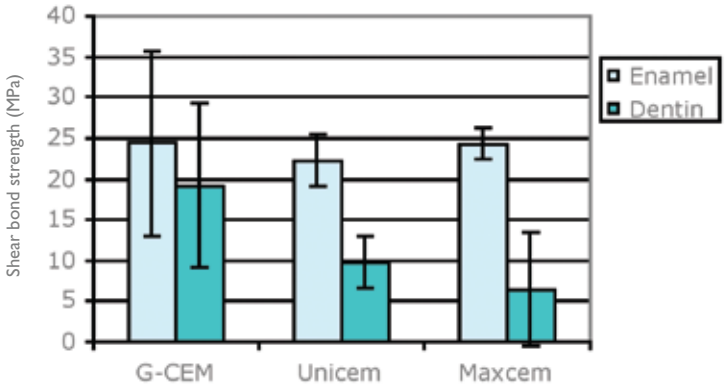
A strong self cure reaction will mean minimal difference between adhesive strengths comparing light cured mode with self cure.

Tensile Bond Strength to bovine enamel (P 600 polished)



For all ceramic restorations under 2mm in thickness light curing of G-CEM will accelerate the setting reaction and deliver strong shear bond strengths to dentine and enamel (light cure mode).

Shear Bond Strength (light cure)



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> G-CEM adhesion to Alumina, Zirconia and Metal

High strength ceramics
(Flexural strength > 600 MPa)

Examples of these include glass infiltrated oxide ceramics, eg Vita Inceram Zirconia*, and Zirconium oxide core materials eg Procera Alumina & Zirconia*, Vita In-Ceram YZ*, 3M.ESPE Lava*, Ivoclar IPS E.max ZirCad*, KaVo Everest Zh-blank* etc.

Effective pre-treatment should be as per the ceramic direction for use. For most high strength ceramics roughing the surface by sandblasting to improve the mechanical retention is recommended. Etching is not effective.

Medium strength ceramics
(Flexural strength < 600 MPa)

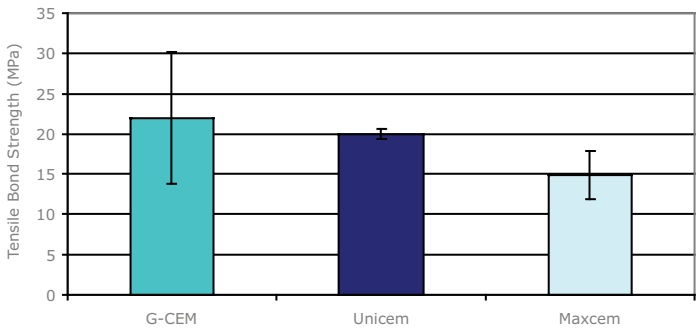
Examples of these include core ceramics, eg GC Initial PC / Empress II* /Vita InCeram Spinell and Alumina*.

Pre-treatment by sandblasting to roughen the surface, or for silicate/feldspar ceramics the option of etching followed by application of a silane coupling agent is recommended (e.g. GC Initial MC, InCeram Alumina*, Empress II* …)

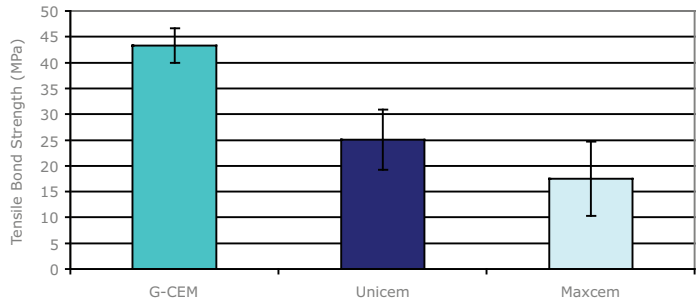
Precious Metal

Pre-treatment by sandblasting is the most effective means of enhancing micromechanical retention.

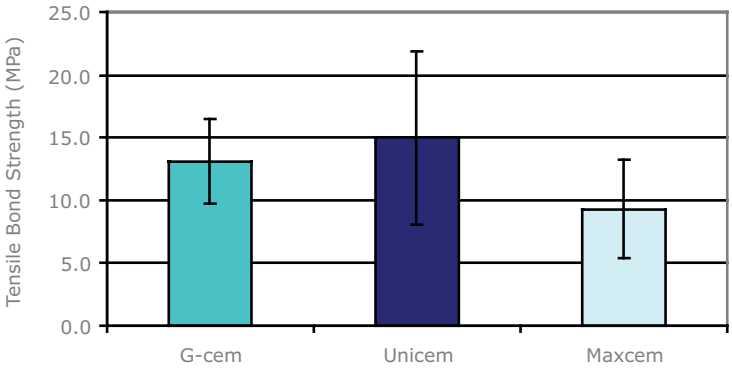
Tensile Bond Strength to Partially Stabilised Zirconia (self cure 24 hour)



Tensile Bond Strength to In-Ceram Alumina (self cure 24 hour)



Bond Strength to Precious Metal (self cure 24 hour)



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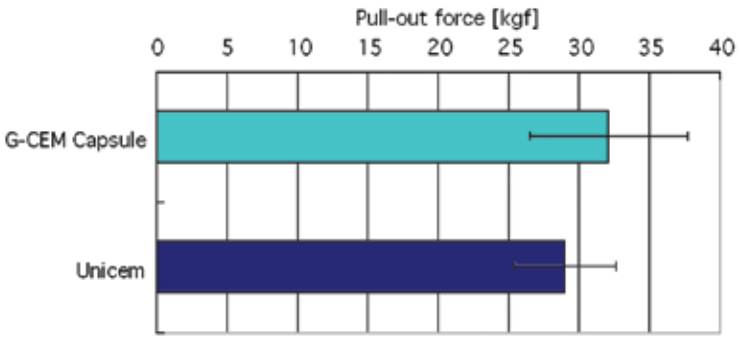
> Post cementation

Important points:

– Refrigeration of G-CEM will lengthen the working time
– Follow pre-treatment instructions as per the dfu for each post
– Use an elongated needle tip, eg. Centrix Accudose Needle Tube, to dispense G-CEM into the post space keeping the tip immersed in the cement to avoid air entrapment
– DO NOT use lentulo spirals to place G-CEM into post holes
– Insert the post immediately following injection of the cement into the post hole. Cementation should be completed within one minute

Pull-out testing of G-CEM: Fiber posts were cemented in G-CEM and then the force required to pull the posts out of the cement was measured.

Post pull-out from cement



Bond strength of G-CEM to dual-cure composite resin used as a core build-up material (Unifil Core).

PRIMING FOR SUBSTRATE	CEMENTING MATERIAL	TENSILE BOND STRENGTH [MPa]	FAILURE MODE
No treatment	G-CEM CAP	16.5 (5.4)	1/4 G-CEM fracture 3/4 G-CEM/Unifil Core boundary
GC Ceramic Primer (A/B)	G-CEM CAP	19.7 (6.6)	1/4 G-CEM fracture 3/4 G-CEM/Unifil Core boundary
GC Composite Primer (light-cured)	G-CEM CAP	18.5 (3.1)	1/4 G-CEM fracture 3/4 G-CEM/Unifil Core boundary

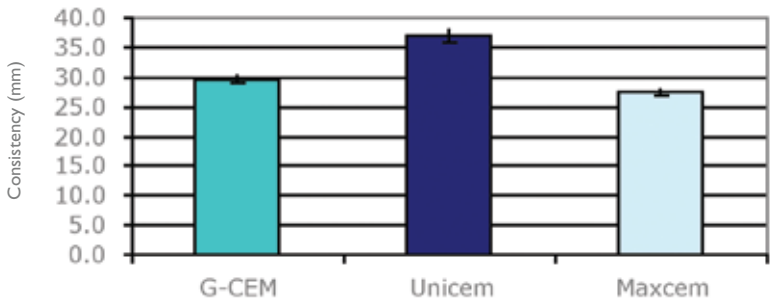
This test simulates the cementation to a composite core or pre-fabricated post and core. The bond strength is only slightly increased with the use of primers.

Substrate: Unifil Core cured plate
Substrate polish: 600-grit SiC paper

> G-CEM:
Other Physical Properties

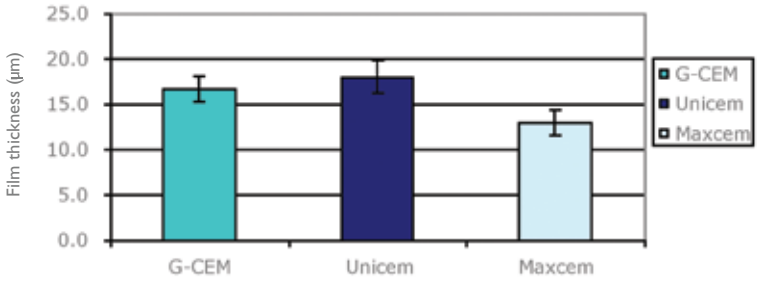
Flow properties. G-CEM has excellent flow characteristics when placed under load.

Flow by load



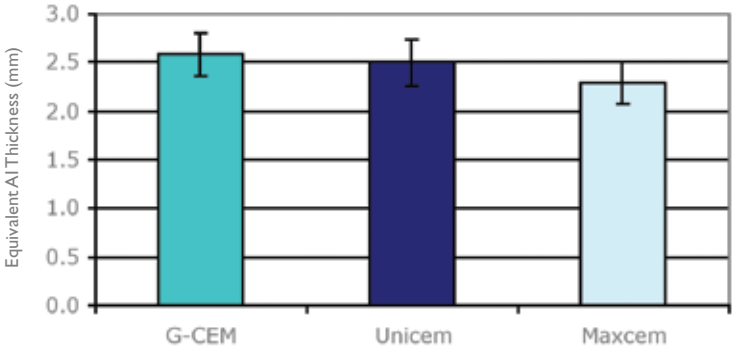
G-CEM has a low film thickness measured as 16.7 microns.

Film Thickness



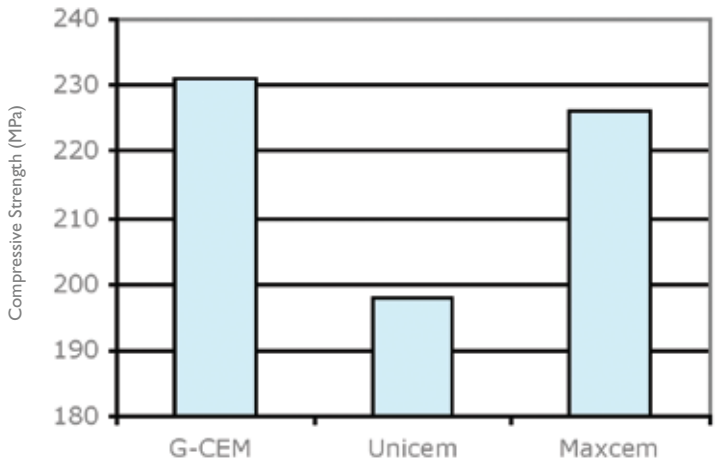
G-CEM is radiopaque.

Radiopacity



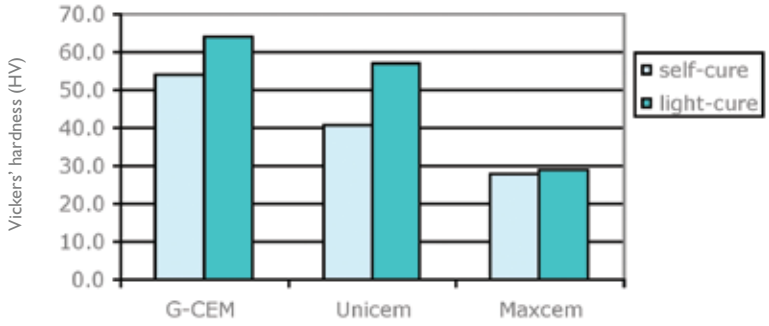
G-CEM has a high compressive strength (self cure) 24 hour.

Compressive strength 24 hour (self cure)



G-CEM has high surface hardness for abrasion resistance at margins.

Surface Hardness 24 hour



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GC Luting Navigation Chart

Ceramic based restorations (core material)	Low and Middle Strength Ceramics (Flexural Strength less than 600MPa)	
Brand names	GC Initial MC /PC; Empress II; E-max Press	
Indications	Inlay,Onlay	Inlay,Onlay,Crowns
GC indicated Luting material	**Fuji Plus and Fuji Cem**	**G-CEM**
Type of material	Resin Reinforced Glass Ionomer	Self adhesive Resin cement
Pre-treatment of Tooth surface	Cleaning and conditioning	Cleaning
Pre-treatment of Ceramic core material	Silicate/feldspar based: etching and silane	Silicate/feldspar based: etching and silane
	Others:roughen the surface by sandblasting	Others:roughen the surface by sandblasting
Important note	The aim of sandblasting / etching is to increase the surface area, obtain higher surface roughness and/or to purify the material.	

Ceramic based restorations (core material)	High Strength Ceramics (Flexural Strength higher than 600MPa)	
Brand names	Procera Alumina and Zirconia; Lava; KaVo Everest; ZirCad; InCeram Zirconia	
Indications	Crowns and Bridges	
GC indicated Luting material	**Fuji Plus / Fuji Cem /Fuji I**	**G-CEM**
Type of material	(Resin Reinforced) Glass Ionomer	Self adhesive Resin cement
Pre-treatment of Tooth surface	Cleaning and Conditioning	Cleaning
Pre-treatment of Ceramic core material	Roughened surface by sandblasting	Roughened surface by sandblasting
Important note	Different manufacturers of core ceramic materials have different advise on pre-treatment (Sandblasting) Consult the corresponding IFU! Internal tests shows no significant bonding improvement	

Product	Manufacturer	Chemical name (main ingredient)	Effectiveness of silane treatment	Flexural Strength [MPa]	Strength
Veneering Ceramics					
GC Initial MC	GC	Feldspar based ceramic	√	90	LOW
GC Initial PC	GC	Feldspar based ceramic	√	110	LOW
Ceramic Core base materials					
IPS e.Max Press	Ivoclar	Lithium disilicate reinforced glass	√	400	LOW
IPS e.Max ZirPress	Ivoclar	Fluorapatite reinforced glass ceramic	√	110	LOW
Empress 2	Ivoclar	Lithium disilicate reinforced glass	√	380	LOW
Vita In-ceram spinel	Vita	Spinel	√	400	MIDDLE
Vita In-ceram alumina	Vita	Alumina (Aluminum oxide)	√	500	MIDDLE
Vita In-ceram 2000 AL cubes	Vita	Alumina (Aluminum oxide)		>500	MIDDLE
Vita In-ceram classic zirconia	Vita	Aluminum oxide (67%), Zirconium	√	600	HIGH
Vita In-ceram 2000 YZ cubes	Vita	PSZ (Partially Stabilized Zirconia)		>900	HIGH
Procera Zirconia	Nobel Biocare	Zirconium Oxide		1100	HIGH
Procera Alumina	Nobel Biocare	Aluminium Oxide		600-700	HIGH

GC Luting Navigation Chart

Composite based restorations	Indirect Composites (Metal Free)	
Brand names	GC Gradia, Composites blocks for Cad/Cam	
Indications	Inlay, Onlay, Crowns and bridges (reinforced), Endo posts	
GC indicated Luting material	**Fuji Plus / Fuji Cem**	**G-CEM**
Type of material	Resin Reinforced Glass Ionomer	Self adhesive Resin cement
Pre-treatment of Tooth surface	Cleaning and conditioning	Cleaning
Pre-treatment of Ceramic core material	Roughen the surface by sandblasting Optional: application of silane	Roughen the surface by sandblasting Optional: application of silane
Important note	The aim of sandblasting is to increase the surface area, obtain higher surface roughness and/or to purify the material.	

Metal based restorations	Porcelain fused to metal, Composite veneered on metal, full metal crowns (on dental alloys like gold,Titanium,Palladium,Non Precious)	
Indications	Inlays, Onlays, crowns and bridges, Endo posts	
GC indicated Luting material	**Fuji Plus / Fuji Cem / Fuji I**	**G-CEM**
Type of material	(Resin Reinforced) Glass Ionomer	Self adhesive Resin cement
Pre-treatment of Tooth surface	Cleaning and Conditioning	Cleaning
Pre-treatment of Metal core material	Roughened surface by sandblasting Optional: application of Metal Primer II	Roughened surface by sandblasting Optional: application of Metal Primer II
Important note	The aim of sandblasting is to increase the surface area, obtain higher surface roughness and/or to purify the material.	

> G-CEM

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So simple to use

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