

# G-ænial

## Technical manual



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## 1.0 Introduction

Since the introduction of Thermoresin LC in 1992 and GRADIA – micro ceramic composite in 2000, GC Corporation has demonstrated its expertise in composite technology. The experience gained in developing indirect composite resins that were aesthetically comparable to porcelain was the starting point of the research for a highly aesthetic direct composite material: Gradia Direct. Today, after 6 years of clinical success of Gradia Direct, and in response to feedback from clinicians, GC is now offering a restorative material combining the same unsurpassed easy aesthetics together with improved handling and increased radiopacity. With G-ænial from GC, create æ-motion with invisible, beautiful and easy restorations.

## 2.0 Product description

G-ænial is a light-cured radiopaque MFR hybrid composite restorative with a combination of 2 types of pre-polymerized resin fillers. Each filler size and concentration has been carefully selected to provide the best aesthetic results while maintaining optimal physical performance and user-friendliness.

G-ænial is available in two different versions: G-ænial Anterior and G-ænial Posterior. These have been formulated to fulfil the different requirements of Anterior and Posterior composites with respect to such features as radiopacity and handling.

By offering different shades, opacities and values with tooth like opalescence and fluorescence, G-ænial Anterior and Posterior are designed to provide an appearance similar to that of the natural tooth. G-ænial was developed to provide the clinician the following advantages:

- Beautiful restorations with an easy shade system
- Optimal handling; a smooth, non-sticky and sculptable formula for G-ænial Anterior, and a more packable formulation for G-ænial Posterior
- Extended working time under operatory light, particularly in Anterior
- Improved radiopacity for patient follow up and control of restorations

## 3.0 Indications for use

### G-ænial Anterior

- Direct restorative for Class III, IV, V cavities.
- Direct restorative for wedge-shaped defects and root surface cavities.
- Direct restorative for veneers and diastema closure.

### G-ænial Posterior

- Direct restorative for Class I and II cavities.



## 4.0 Composition

G-ænial is classified as an MFR hybrid composite with a combination of 2 types of pre-polymerized resin fillers. It is composed of matrix, fillers, pigment and photo-initiators. Variations of monomer concentration, filler types and content between the Anterior and Posterior versions make the material ideally suited to its uses, with more radiopacity in G-ænial Posterior and softer handling in G-ænial Anterior.

Table 1: Main composition of G-ænial Anterior and Posterior

Components		G-ænial Anterior	G-ænial Posterior
Methacrylate Monomers		X	X
Pre-polymerized fillers 16-17 $\mu$	Silica containing	X	X
	Strontium and Lanthanoid Fluoride containing	X	X
Inorganic filler > 100 nm	Silica	X	-
	Fluoroaluminosilicate	-	X
Inorganic filler < 100 nm	Fumed silica	X	X
Pigments		Trace	Trace
Catalysts		Trace	Trace

### 4.1 Filler

Two different kind of **pre-polymerized fillers** are used, offering clinical useful radiopacity while keeping perfect aesthetics both in Anterior and Posterior. The pre-polymerized fillers also contribute to the low level of shrinkage found with G-ænial. They are produced by polymerizing a resin matrix in which micro-fillers were incorporated, and then milling the polymerized resin into particles averaging 16 to 17 $\mu$  in size.

**Fluoroaluminosilicate** glass is added to the Posterior formulation for increased radiopacity while Silica is used in the Anterior formulation.

Finally, **fumed silica** is dispersed between the pre-polymerized fillers and the other inorganic fillers.

Figure 1: SEM Image of the filler system in G-ænial Anterior and Posterior. Magnification 2,500

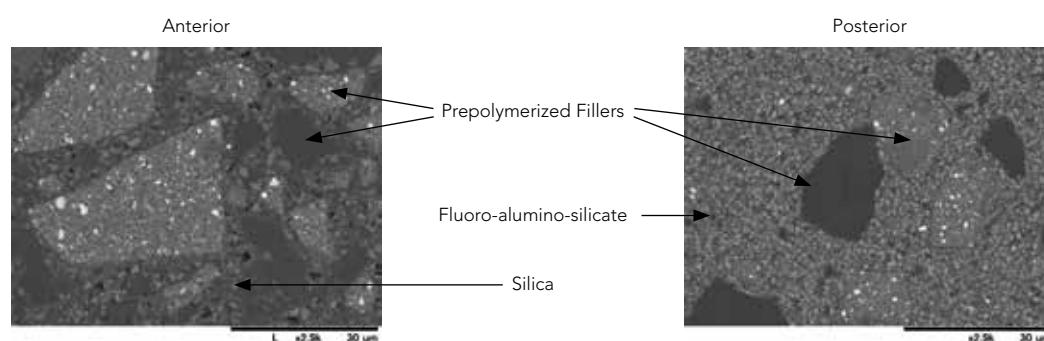
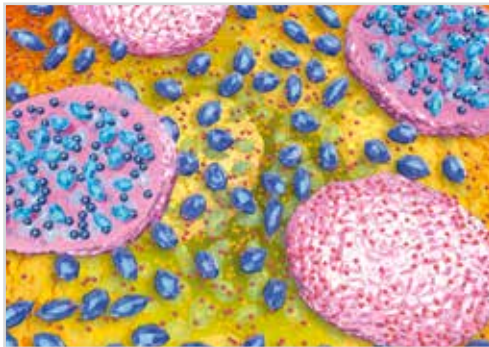


Figure 2: Structural drawing of the filler system

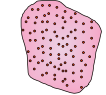


**Prepolymerized Filler** 17  $\mu\text{m}$



400 nm Strontium Glass  
100 nm lanthanoid fluoride

**Prepolymerized Filler** 16  $\mu\text{m}$



16 nm silica

**Inorganic Filler** 850 nm



Anterior : Silica glass  
Posterior : FAISi glass

**Inorganic Filler** 16 nm



Fumed silica

## 4.2 Matrix

The matrix consists of a mixture of urethane dimethacrylate (UDMA) and dimethacrylate co-monomers. G-ænial is bis-GMA free.

### 4.3 Interfaces

To improve the bond between the silica and matrix resin, the silica surfaces are treated hydrophobically with dimethyl constituents rather than with silanol. This hydrophobic treatment improves the intimate contact between the silica and the matrix because both ingredients will attract each other. Moreover, this type of dimethyl-treated silica is more stable than silica treated with methacryloxysilane, resulting in an improved shelf life with less risk of stiffening of the material during storage.

The Fluoroaluminosilicate glass used in G-ænial Posterior is silanated.

Three types of interaction occur at the pre-polymerized filler and resin matrix interface, helping to prevent disruption of the fillers and thereby maintaining the long-term integrity of the restoration in time.

The three types of interaction are as follows:

- 1 Covalent bonds derived from residual  $C=C$ .
- 2 Hydrogen bonds from polar constituents, such as  $-OH$ ,  $-NH$ , and  $-C=O$ .
- 3 Hydrophobic interactions between organic groups (e.g. alkyls).



### 4.4 Initiators

G-ænial uses a combination of camphorquinone and amine as the catalyst. Light activation can be carried out with quartz halogen, plasma or LED curing units.



## 5.0 Shades

### 5.1 Introduction

One of the biggest challenges in prosthetic and restorative dentistry is to reproduce Mother Nature's well balanced tooth colour harmony. Patients demand restorations that equal or surpass the aesthetics of nature and that are indiscernible from the tooth structure. One of the main objectives in developing G-ænial was to create a state-of-the-art composite that would offer predictable aesthetics in both simple and complex situations. With G-ænial, it is possible for the clinician to balance dental science and the artistry of a patient's smile.

#### It is not only about translucency, value, hue and chroma...

Colour depends on three factors: the colour (hue), the saturation of the colour (chroma) and the lightness/darkness of the colour (value). In dentistry, a fourth factor, translucency, is equally important. Translucency is defined as the property to allow light to pass through, but only diffusely; as a result, an object on the other side is not clearly distinguishable. Opaque materials are not translucent.

Translucency of a composite material is necessary to adjust the value of the restoration to that of the natural tooth and avoid a non-aesthetic opaque result. However, restoration thickness will vary in a cavity, giving more or less translucency. Light reflection will also differ depending on the angle from which the restoration is observed. Therefore, it can be assumed that translucency and variations in opacity alone will not result in a chameleon effect.

#### The natural reflection of light from the tooth determines the colour observed by the human eye.

When we look at a tooth, reflected light is observed that consists mainly of mirror and diffused reflection. **Mirror reflection** determines the quality of the gloss, while we "feel" the hue, chroma, value and translucency from **diffusively reflected light**.

Figure 3: Transmission, Fluorescence and reflection of light on the tooth structure. Courtesy Mr. F. Feydel and Dr. E. D'Incau, France

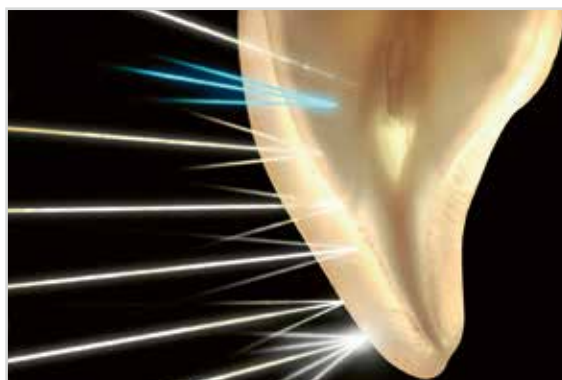


Figure 4: Light reflection of a natural tooth varies according to the diverse refractive index of its structure (enamel, dentin, enamodentinal junction...)

Light is scattered and reflected by internal tooth structures (e.g., enamel crystals, dentine-enamel junction and dentinal tubules). Certain wavelengths are absorbed, whereas the remaining light possessing information on tooth hue, chroma, value and translucency is diffusively reflected. For example, enamel mostly consists of apatite crystals and will allow light to pass through without much scattering while dentin has a more complex structure of hydroxyapatite crystals and collagen and will scatter the light in all directions.

### Measuring the scattering properties of a composite: the goniophotometer

The light scattering property of a material can be evaluated using a goniophotometer. This is designed to measure the intensity of transmitted light at various angles (-90 to +90 degrees).

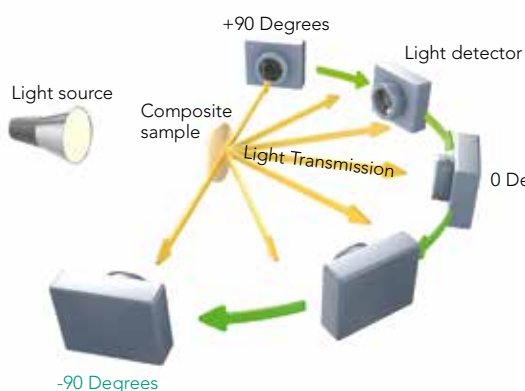


Figure 5: System set-up of the goniophotometer

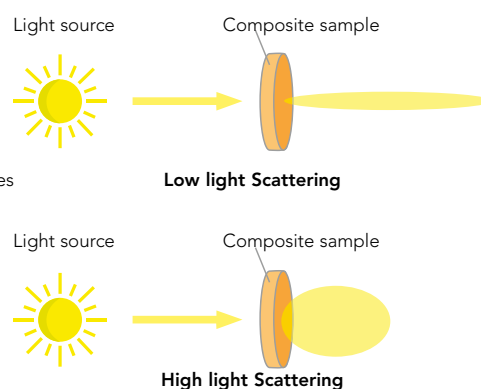


Figure 6: Observation of light diffusion with different composites

Figure 7 shows artificial cavities in a block of composite shade A3 that were filled with 2 different composites with shade A2. Only one of these is able to mimic the surrounding environment. After analysing their light diffusing properties with the goniophotometer, it appears that the one which adapts the best possesses higher scattering properties.



Block of composite shade A3 with cavity      Low-scattering composite      High-scattering composite

Figure 7: A3 cavity filled with A2 composite

**These results suggest that light scattering is even more important than hue to ensure that the material is invisible.**

### What makes a composite restoration become invisible?

The ability of a composite to scatter light and diffusely reflect it similarly to the natural tooth makes it possible to achieve a perfect match with the surrounding tooth structure. A composite material becomes invisible only when it has this scattering property and can then be used in a single shade layer technique.

Like the tooth, G-ænial contains different interfaces with different optical properties, resulting in varied reflection of light. The excellent scattering ability of G-ænial is related to the **extremely diverse structural composition, which results in it mimicking the reflectivity of a natural tooth.**

Figure 8: Diffuse reflection on natural tooth structure

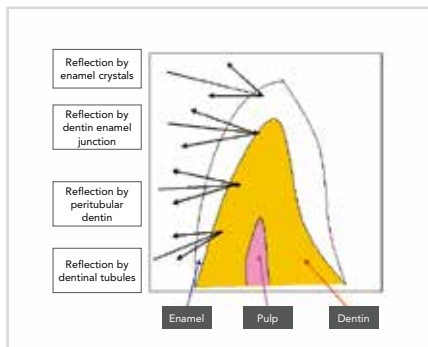
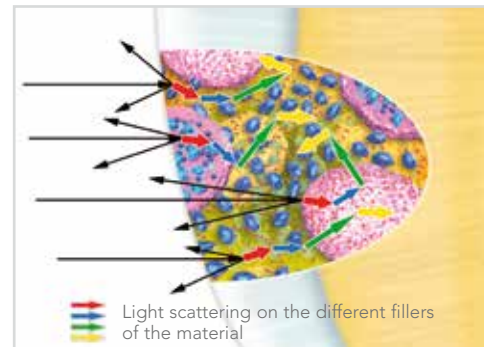


Figure 9: Diffuse reflection with G-ænial



### The scattering properties of G-ænial provide its unique blending abilities

G-ænial Anterior exhibits the highest light scattering amongst the competitors tested. An excellent chameleon effect can thus be achieved, resulting in invisible restorations. **This is the main reason why highly aesthetic results can be obtained with only one shade of G-ænial**, as can be seen on Figure 11.

Figure 10: Scattering properties of G-ænial Anterior vs. Competitors

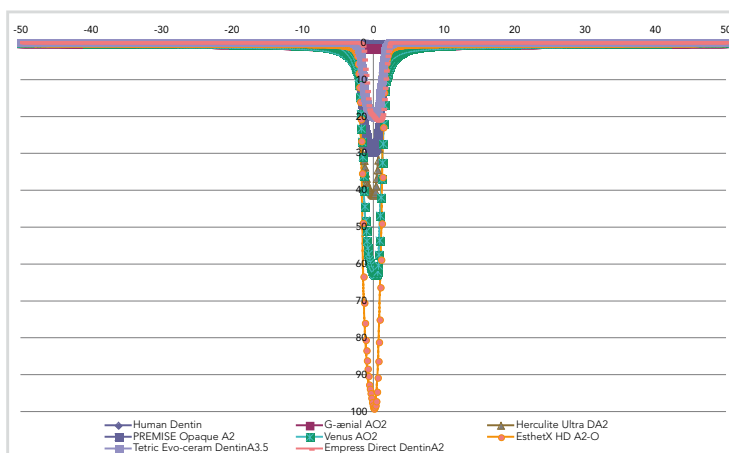


Figure 11: Single shade restoration with G-ænial Posterior Courtesy of Dr. Tapia, Spain



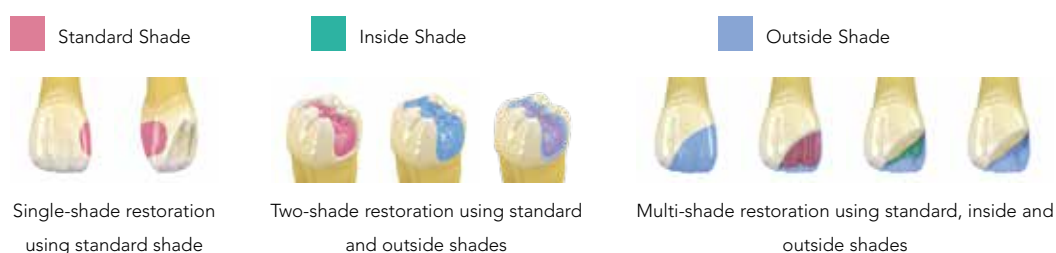
**Note the perfect blending ability of the Standard Shade.**

## 5.2 Shade system

G-ænial offers flexibility, enabling placement of aesthetically invisible single-shade restorations or aesthetic masterpieces with a multi-shade build-up. In order to achieve this, 3 clearly differentiated shade groups have been defined for G-ænial:

- Standard shades: for the single-shade restorations
- Outside shades: placed on top of Standard shades in aesthetically demanding cases
- Inside shades: placed underneath Standard shades in aesthetically demanding cases

Figure 12: Single- and multi-shade restorations using G-ænial



### Standard shades

Standard shades have been designed to be used mainly in the single-shade technique and present a very delicate balance between value, translucency, hue and chroma. They are grouped into A (reddish-brown), B (reddish-yellow), C (grey), Bleach and Cervical shades. Each shade from the same group has the same hue and conforms to the arrangement of the Vita® classical shade guide, with an increasing amount of chroma per group.

Table 2: G-ænial standard shades

Hue			
XBW			
BW	A1	B1	
	A2	B2	
	A3	B3	C3
	A3.5		
	A4		
		CV	
		CVD	

XBW: Extra Bleach White; BW: Bleach White; CV: Cervical; CVD: Cervical Dark

As can be seen on Figure 13, G-ænial shade A3 applied to the central part of single Vita shade guide tabs has unique blending and invisible properties: the material adapts to the underneath shade tabs and perfectly matches the environment. As a result, one shade will be sufficient for most cavities.

Figure 13: Blending (chameleon) effect observed with G-ænial A3 when applied on diverse Vita shade tabs



## Inside and Outside Special shades

Although excellent aesthetics can be achieved for the majority of cases with just a single shade, there may be times when a multi-shade technique is preferred, such as when extensive restorations are required. G-ænial offers two additional types of shades to choose from, called Special Shades. Inside shades are placed underneath a Standard Shade, and are more opaque to block the transmission of light from the oral cavity. Outside shades are placed on top of Standard shades to copy the value (lightness/darkness) of a tooth, to mimic age-dependent changes in the enamel and to give more “depth” to a final restoration.

### Outside Special Shades – replacing enamel

Outside special shades give an extra dimension to the restoration. Monochromatic composite restorations are often found to have the appearance of less vitality compared to ceramic. This happens when the value of the restoration is not appropriate for the tooth; the enamel surface is the main contributor to the value of a tooth.

Enamel changes over time, becoming thinner and more translucent. It also decreases in value from high (whiter) to low (darker). Outside special shades are designed to reflect these changes, helping the dentist to create restorations with age-appropriate values. Depending on the intended use, several slightly-pigmented outside shades can be used to obtain a highly indication-specific hue and chroma. Due to the uniqueness of these shades, a classification to Vita is not possible. For shade reference, the G-ænial shade guide should be used.

Outside Shades offer the same degree of translucency, but have different values to provide for age-appropriate values.

Figure 14: Outside shades selected to replace enamel in accordance with the age of the patient

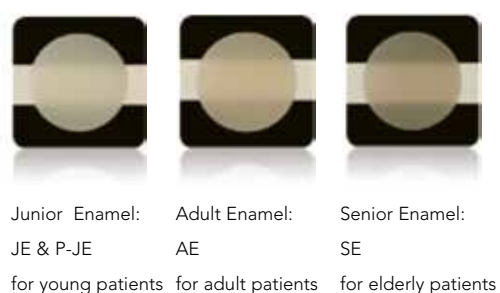
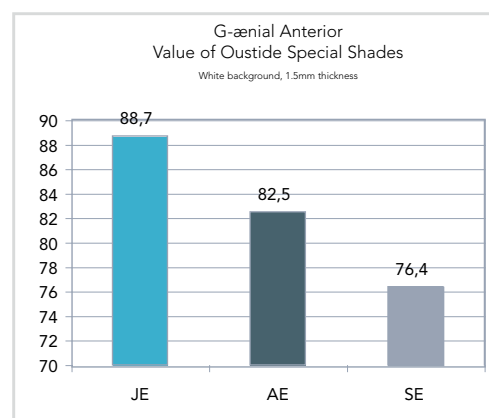


Figure 15: Outside shades with similar translucency but different values



At the same time as the thickness of the enamel decreases with age, the translucency increases. To mimic this change at, for instance, the incisal edges of teeth, IE (Incisal Enamel) and TE (Translucent Enamel) have been developed.

Figure 16: Incisal (IE &amp; P-IE) and Translucent (TE) Enamel shades

IE & P-IE can be applied on the incisal edge, occlusal third and proximal surfaces in adult patients



In elderly patients, TE can be applied on the occlusal third, incisal edge and proximal surfaces



Additionally, the TE shade can be used to reproduce the transparent layer that can be observed at the enamodentinal junction (Figure 17). This will simulate a natural in-depth effect.



Figure 17: Mesio-distal section of an incisor . Courtesy Mr. F. Feydel and Dr. E. D'Incau, France

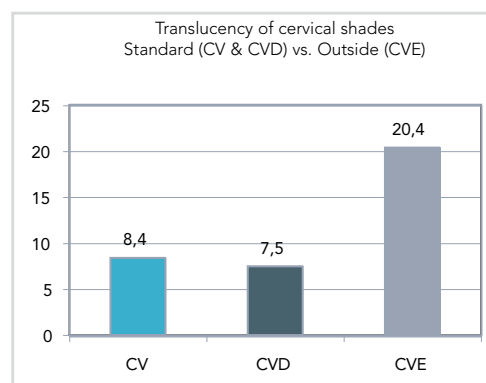
As patients are becoming older and teeth remain longer in the mouth, special attention must be paid to the aesthetics in the cervical area. The application of CVE (Cervical Enamel) will increase the translucency and therefore the vividness of Class V restorations significantly.

Figure 19: Cervical Enamel Shade (CVE)

CVE offers the appropriate translucency to let the cervical dentin shine through



Figure 18: Cervical Enamel brings translucency to cervical restorations



### Inside Special Shades – adding opacity

Inside special shades have a higher opacity (lower translucency) than standard shades and are available as AO2, AO3 and AO4. Conforming to the Vita classification, these 3 shades have similar hue but an increased chroma content. Opacity is kept at the same level.

Inside special shades are placed underneath a Standard Shade to add warmth to the final restoration and, compared to standard shades, have an increased opacity to eradicate the characteristic 'dark shine' throughout the mouth. They are also particularly useful to mask dentin discolorations and to hide the preparation line in large class IV restorations.

Figure 20: Inside Shades are less translucent than Standard Shades

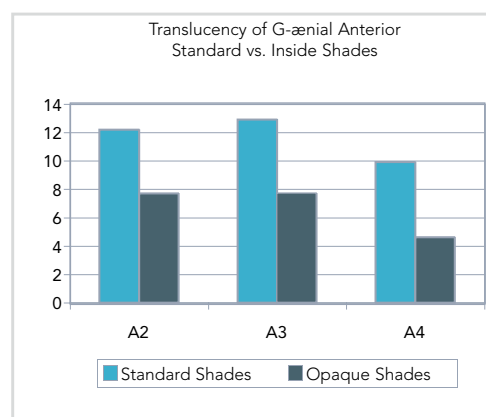


Figure 21: Differences in opacity between G-ænial Standard A2 and Inside AO2

G-ænial Anterior Standard Shade  
A2, ΔL 12,4



G-ænial Anterior Special Inside  
Shade AO2, ΔL 6,7



## 5.3 Shade taking

It is advised to always select composite shade(s) after cleaning the tooth and before tooth preparation. It is also important to select the shade(s) prior to rubber dam placement, since desiccated teeth are lighter in value and if used for shade matching could result in the wrong shade being selected.

### Single-shade layering technique

Worldwide, the VITAPAN Classical shade guide is the guide dentists use when selecting shades. Consequently, our composite shades are mostly in line with this shade guide. For shade matching with G-ænial, reference should be made to the Body section part of the tabs of this guide. Alternatively, the G-ænial shade guide can be used to select the appropriate Standard Shade for the clinical situation.

### Multi-shade layering technique

In some cases, e.g., larger-sized cavities or cases with high aesthetic demands, more shades may be required with different translucencies and values. These can be selected from the G-ænial Special Shades.

Figure 22 Cross-section of an incisor showing the dental structures



Outside Shades: These should be used to replace the enamel layer (part 3 of Figure 22)

Standard Shades: These should be used to replace most of the lost dental structure (mainly dentin) (part 2 of Figure 22).

Insides Shades: These should be used to bring opacity to the part of the restoration replacing dentin (part 1 of Figure 22).

### Step1: Taking the value

The value is the most underestimated parameter in shade selection. In most cases, only hue and chroma data are determined in order to obtain information on the required composite “shade”. From the images below, it can be seen that a lack of value results in a less life-like image.

Figure 23: Influence of value on colour perception



Full colours - combination of hue, chroma and value



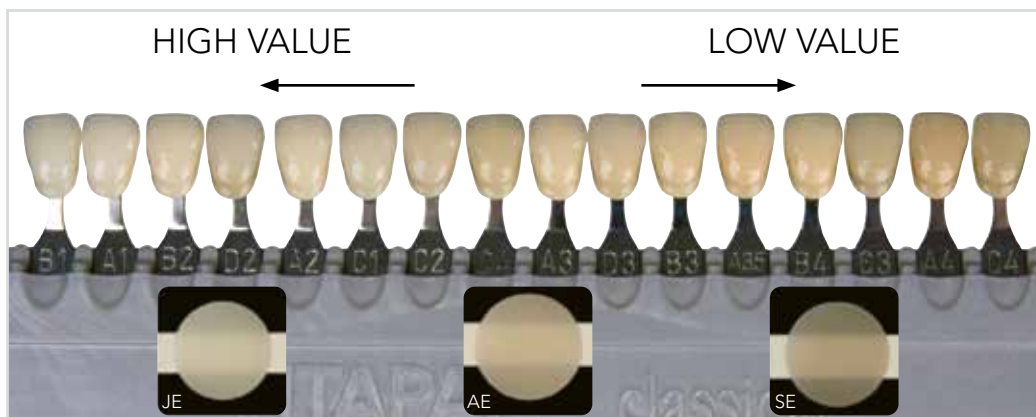
Black and white - only values are seen



“Full colours” but with less value

The incisal/approximal areas of the teeth are good sites to determine the value. The three main G-ænial shades which will help in reproducing these values are the age-related shades: JE (Junior Enamel), AE (Adult Enamel) and SE (senior Enamel). Alternatively, the classical Vita shade guide can be re-organised according to value, as shown in Figure 24.

Figure 24: The Classical VitaPan Shade guide was reorganised according to the value of the shade tabs. A correspondence to the 3 main value shades from G-ænial (JE, AE and SE) can be observed.



### Step 2: Choosing the hue

The hue is the pure colour itself. It can be chosen from the 5 groups of the Standard shade (A, B, C, Cervical and Bleach). In order to best choose the hue, it is recommended to look at the colour of the dentin core, especially where enamel is thin, i.e., at the cervical area of the natural tooth. The cervical enamel layer is particularly thin around the canines.

### Step 3: Establishing the chroma

The chroma indicates the lightness or darkness of a shade, in one particular hue group. The chroma can be determined by looking at the intensity of the previously defined hue. For example, knowing that the hue is A, the dentist will define how intense this is: A1, A2, A3, et cetera.

Hue and chroma are mainly determined using the G-ænial Shade guide. Alternatively, the classical Vita shade guide can be used, paying attention to cover and ignore the cervical part of the tab which is too dark and could result in the selection of an incorrect colour.

### Additional tips for better shade matching

In complex cases, a mock-up can help selection of the best combination of shades. This should be applied on the tooth before the bonding procedure is started, taking care that the tooth is not desiccated. When finishing the restoration, it is important to reproduce the morphology and anatomy of the tooth as this will contribute to light reflection that is similar to that of the adjacent tooth and result in better aesthetic integration of the restoration.

### Shade guide

Although most of G-ænial shades are linked to the Vita classical shade guide, several Special outside shades and some Standard shades (Bleach, Cervical) are custom. The G-ænial shade guide is fabricated from plastic and each respective shade guide finger is wedge-shaped with increasing thickness. This design was chosen to offer dentists the possibility of judging the influence of the thickness of a composite layer on the shade.

## 5.4 Clinical hints

In most cases, Standard shades alone will be used and will result in natural-looking aesthetic restorations.

In some more aesthetically demanding cases, however, Inside and Outside shades will be required to bring life to the restoration. Table 3 provides possible shade combinations.

Table 3: Possible shade combinations for large multi-layer enamel restorations

	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>A3.5</b>	<b>A4</b>	<b>B1</b>	<b>B2</b>	<b>B3</b>	<b>C3</b>
Inside special	BW	AO2	AO3	AO3	AO4	BW	AO2	AO3	AO4
Standard	A1	A	A3	A3.5	A	B1	B2	B3	C3
Outside special	<b>JE</b>	<b>AE</b>	<b>AE</b>	<b>AE</b>	<b>AE</b>	<b>JE</b>	<b>JE</b>	<b>AE</b>	<b>AE</b>

Table 4: Restoring enamel with age-appropriate shades

	<b>Junior</b>	<b>Adult</b>	<b>Senior</b>
Enamel body	JE	AE	SE
Incisal edge	JE	IE	TE

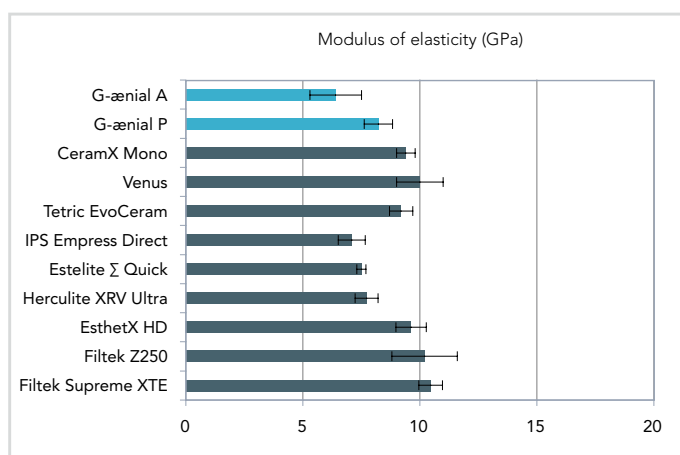
In order to ease the shade selection and support the practitioner in the multi-layering build-up, GC has developed a unique 3D interactive tool: the G-ænial Configurator. For more information on GC G-ænial Configurator, please ask your local GC representative. The G-ænial Quick start Configurator is available on our website: <http://www.gceurope.com/download/multimedia.php>

## 6.0 Physical properties

### 6.1 Modulus of elasticity and fracture toughness

The modulus of elasticity (Young's modulus) – a measure of the rigidity of the material – is defined by the initial slope of a stress-strain curve. A material with a high modulus is stiff and rigid, whereas a material with a low modulus is flexible. Ideally, a material should not have a **too high** modulus of elasticity as brittle materials are less able to buffer masticatory pressure.

Figure 25: Modulus of elasticity of various composite materials. Source: GC Corporation



The modulus of elasticity of G-ænial was determined according to the ISO 4049:2000 specifications.

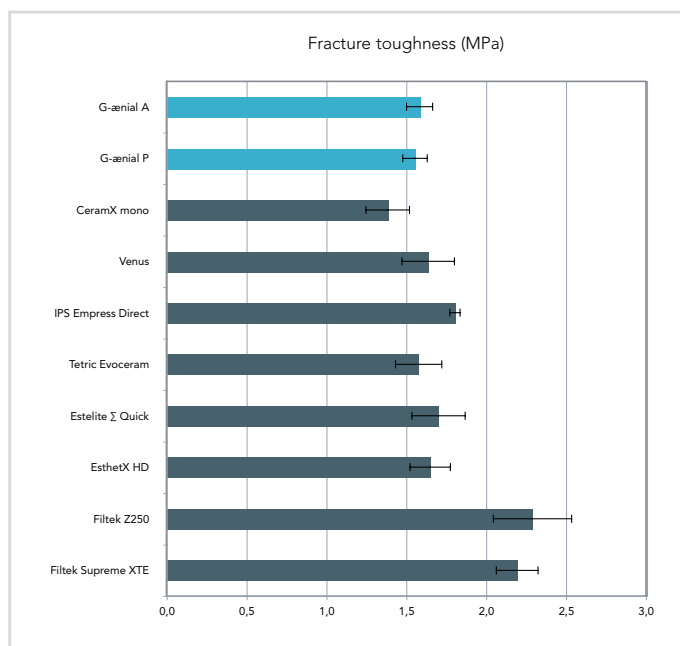
**G-ænial Anterior is shown to be amongst the most flexible of the tested composites.**

G-ænial Posterior shows a similar flexibility compared to most composites tested.

Flexible materials have the ability to buffer forces in (high) stress-bearing areas.

Fracture toughness is a measure of a material's ability to resist the propagation of a formed crack, also defined as the toughness against bending stress. The toughness is related to the energy absorbed in the bending process. The toughness is calculated as the underlying area of the Stress-Strain curve. A higher value for fracture toughness implies a better resistance to the catastrophic propagation of cracks.

Figure 26: Fracture toughness of various composite materials. Source: GC Corporation



Test method is based on ASTM E-399, Fracture toughness test

The following can be concluded from this test:

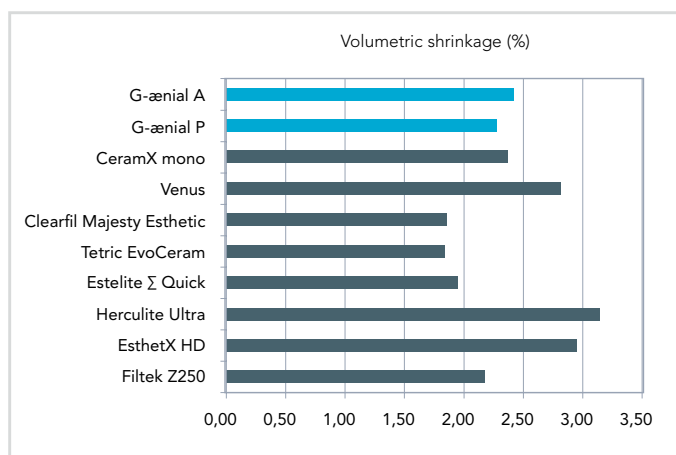
G-ænial shows an ability to resist the propagation of cracks similar to most of the competitors tested and better than Tetric Evo Ceram, CeramX Mono.

## 6.2 Shrinkage

### Volumetric shrinkage (%)

Pre- and post-curing composite resin densities were measured and the polymerization shrinkage calculated accordingly

Figure 27: Volumetric shrinkage of various composites Source: GC Corporation

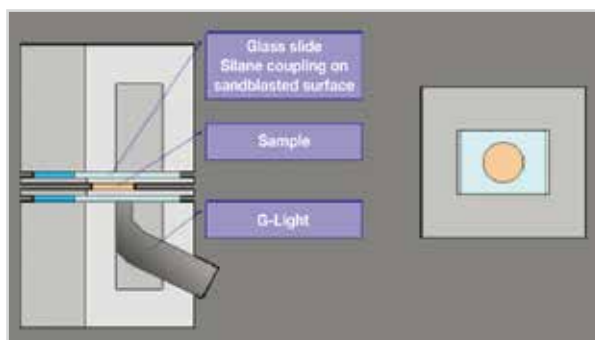


The volumetric shrinkage was measured following ISO Draft Date: 2007-07-10 (Dentistry - Polymerization shrinkage of filling materials) specifications.

This study demonstrated that **the volumetric shrinkage of G-ænial is within the average of the tested composites.**

### Shrinkage stress

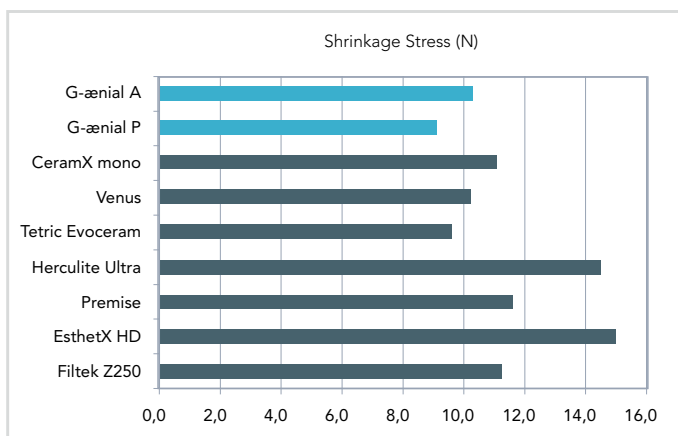
Figure 28: Shrinkage stress test with universal testing machine



The sample was light-cured for 40 seconds from the underside using a G-Light 11mm fiber rod, then light-cured for 20 seconds from above. The setting shrinkage stress was measured for 20 minutes and the highest figure reached was recorded as the shrinkage stress.

Figure 30: Shrinkage stress of various composites Source: GC Corporation

Figure 29: Shrinkage stress of various composites Source: GC Corporation



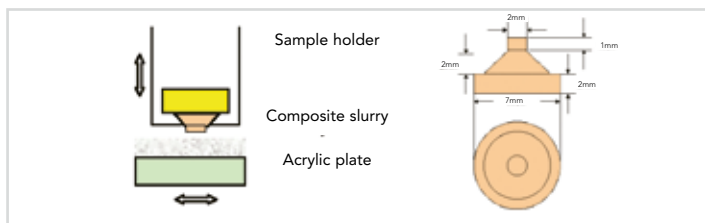
The volumetric shrinkage was measured following ISO Draft Date: 2007-07-10 (Dentistry - Polymerization shrinkage of filling materials) specifications.

This study demonstrated that **the shrinkage stress generated by G-ænial is amongst the lowest of the tested composites.**

### 6.3 Three – body wear resistance

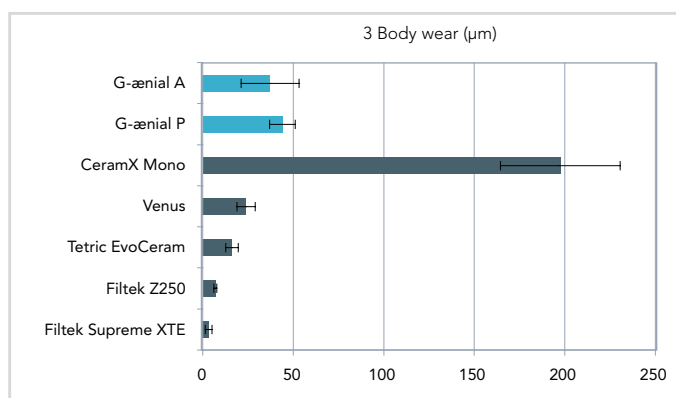
Wear is the loss of material resulting from removal of the material through the contact of two or more materials. The three-body wear test simulates wear in the oral cavity using a slurry of PMMA and glycerol as the intermediate abrasive agent and an acrylic plate as the opposing material.

Figure 30: Three-Body wear resistance test set-up



To measure three-body wear resistance, composite specimens were prepared and moved up and down along a 5 cm path at a rate of 30 strokes per minute. They were held in indirect contact with an acrylic plate under a load of 350 gf load and, simultaneously, the sample holder slid horizontally along a 2 cm path at a rate of 30 strokes per minute. A mixture of PMMA and glycerol (1:1 vol%) was used as an intermediate abrasive. After 100,000 cycles (with one complete lateral and vertical movement being defined as one cycle), the material wear was measured by evaluating by measuring height loss.

Figure 31: Three-body wear of various composites Source: GC Corporation



Based on this test, it can be concluded that:

- 1 G-aenial has similar wear to nanohybrid composites such as EsthetX or Venus.
- 2 The wear of G-aenial is significantly less than the wear of the nanohybrid composite CeramX.

## 6.4 Gloss rate

### Test Set-up

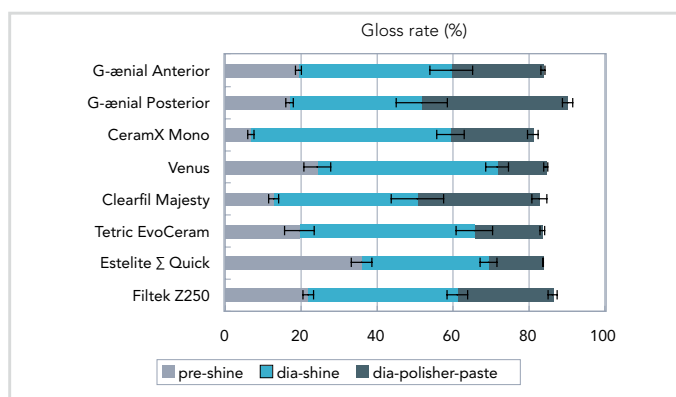
Samples of materials with a 15mm diameter and 1.5mm thickness were prepared.

The surface was first polished with 600 grit paper and then finished for 2 minutes with a silicone point (Pre Shine, GC). The surface gloss rate was then measured for the first time with a VG-2000, Nippon Denshoku.

The surface was then polished for 2 minutes with a diamond silicone point (Dia-Shine, GC) and the surface gloss rate measured for the second time.

Lastly, the surface was polished for 2 minutes with a Diamond polishing paste with buff for polishing and super-polishing (Dia Polisher Paste, GC). The surface gloss rate was then measured for the third time.

Figure 32: Gloss rate of various composites Source: GC Corporation

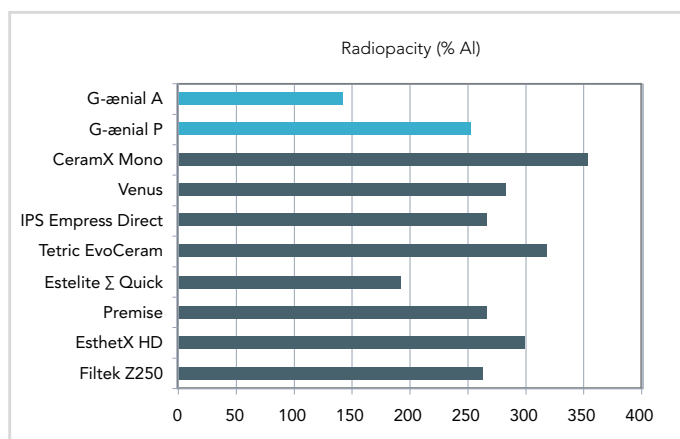


Based on this test, it can be concluded that the **gloss rate of G-aenial is similar to that of the other tested composites.**

## 6.5 Radiopacity

Literature has reported that at 1 mm, dentin and enamel have radiopacities of 1.5 mm Al and 2.25 mm Al, respectively (Attar et al, 2003; ADA, 2006).

Figure 33: Radiopacity of various composites Source: GC Corporation, test according to ISO 4049:2000 specifications



**G-ænial Anterior offers a clinically relevant radiopacity, without compromising on highly aesthetic results.**

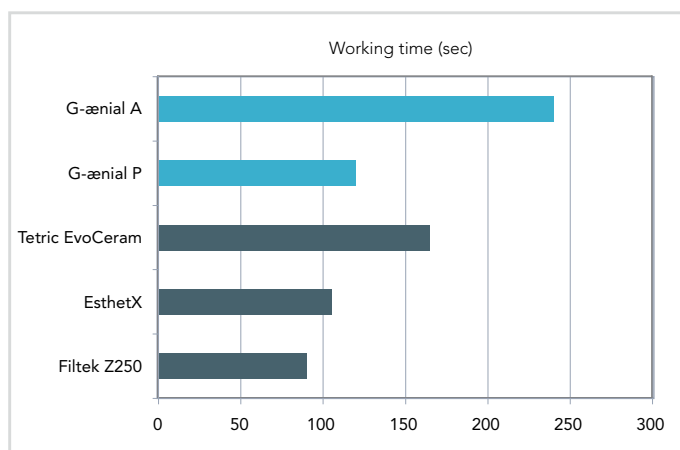
Being more radiopaque, G-ænial Posterior fulfils the requirements for posterior restorations. This is possible through the use of lanthanoid, strontium and fluoroaluminosilicate particles.

Figure 34: X-rays of G-ænial Posterior (mesio-occlusal restoration on tooth 37) and Anterior (Distal restoration on tooth 21)



## 6.6 Working time

Figure 35: Working time of various composites Source: GC Corporation



The working time was evaluated according to ISO4049:2000.

Based on this test, the working time of G-ænial Posterior is similar to the other tested composites.

**G-ænial Anterior demonstrated a longer working time of about 4 minutes in total**, which is favourable when creating multi-layer aesthetic restorations.

## 6.7 Depth of cure

The depth of cure of G-ænial was determined with a scraping technique described in the ISO 4049:2000 specifications.

Table 5: G-ænial Anterior: Irradiation time and effective depth of cure

Shade	Irradiation time	
	Plasma arc (2000 mW/cm <sup>2</sup> )	3 sec.
	GC G-Light (1200 mW/cm <sup>2</sup> )	10 sec.
	Halogen / LED (700 mW/cm <sup>2</sup> )	20 sec.
TE, IE, JE, SE, CVE	3.0 mm	3.5 mm
A1, A2, B1, B2, XBW, BW, AE	2.5 mm	3.0 mm
A3, B3	2.0 mm	3.0 mm
A3.5, A4, C3, AO2, AO3, AO4, CV, CVD	1.5 mm	2.5 mm

Table 6: G-ænial Posterior: Irradiation time and effective depth of cure

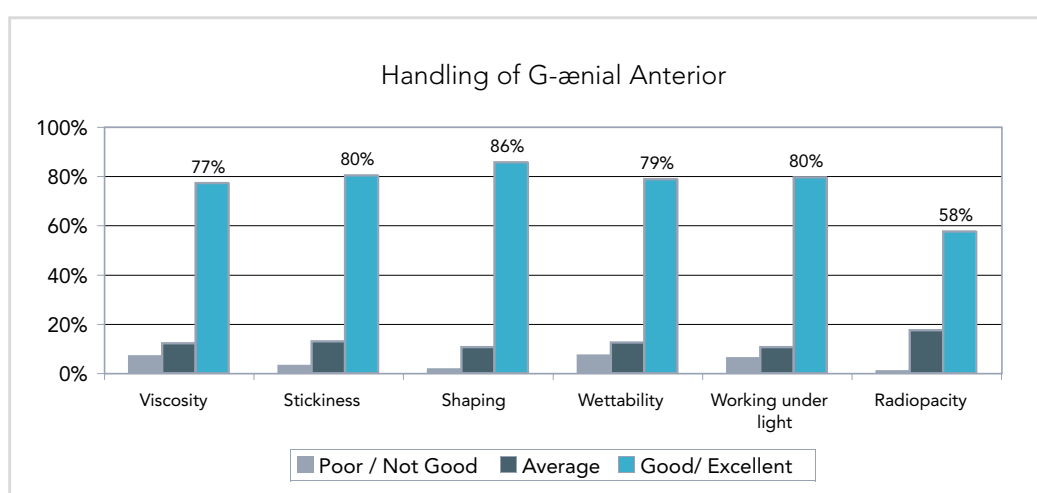
Shade	Irradiation time	
	Plasma arc (2000 mW/cm <sup>2</sup> )	3 sec.
	GC G-Light (1200 mW/cm <sup>2</sup> )	10 sec.
	Halogen / LED (700 mW/cm <sup>2</sup> )	20 sec.
P-A1, P-A2, P-JE, P-IE	2.5 mm	3.0 mm
P-A3, P-A3.5	2.0 mm	3.0 mm

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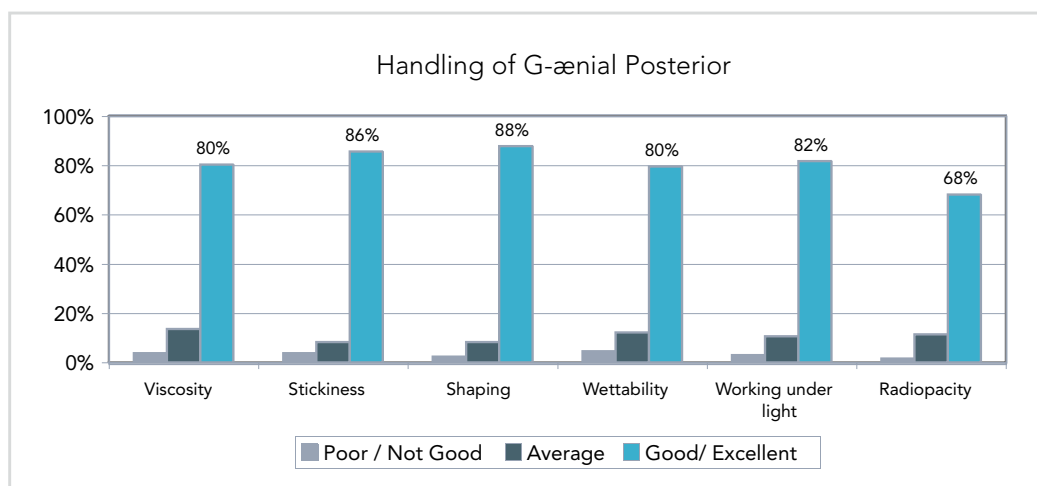
## 7.0 Field evaluation

Major objectives in the development of G-ænial Anterior and Posterior were to develop a material with easy handling properties, perfect shade matching with an easy shade selection, and radiopacity. Following in-vitro handling tests to determine the best viscosities, a large field study was conducted with 132 dentists in more than 20 European countries to test if these improvements were achieved.

### 7.1 Handling

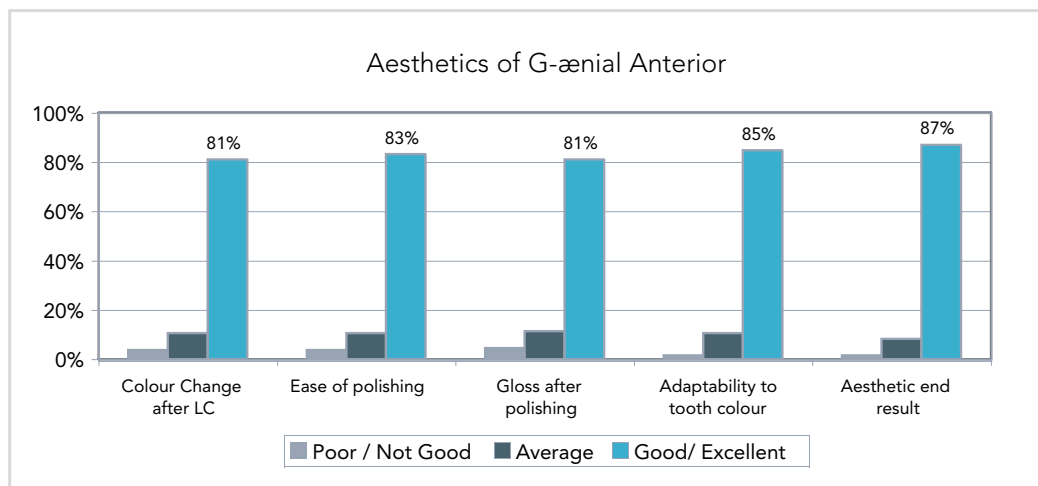


The handling of G-ænial Anterior was rated favourably, including the radiopacity which is new in the Anterior version.

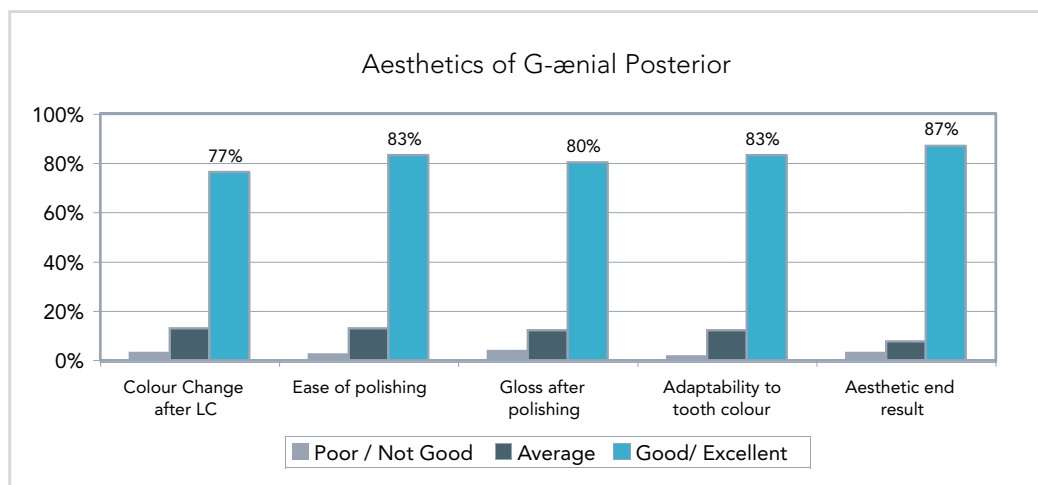


Regarding G-ænial Posterior, the handling was also evaluated as very good. 88% of users rated the shaping properties of G-ænial Posterior as good or excellent (respectively 37% excellent and 51% good).

## 7.2 Aesthetics



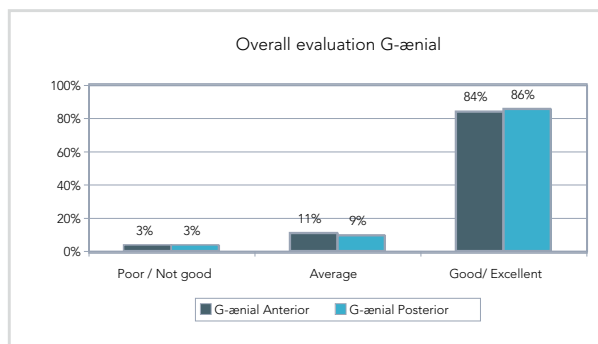
With G-ænial, only one shade is necessary for restoration of most cavities. Therefore, the test was performed with a choice of A2 or A3 only in order to check the blending ability of the material. Several users highlighted that the aesthetics were very good with a single shade. The aesthetic end result was rated good (39%) or excellent (48%).



In the posterior region, the shade available for the test was P-A2. Once again, the aesthetics were rated very positively. The colour adaptation was judged as good (43%) or excellent (40%). One user commented: only one colour used, but appears to be useable as a "universal" shade.

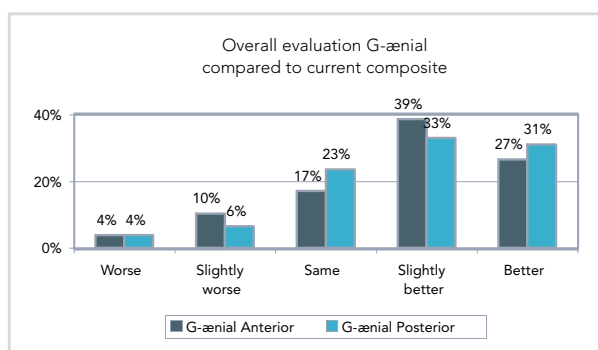
## 7.3 Overall evaluation

Approximately 85% of dentists judged G-ænial as good to excellent. Both the Anterior and Posterior version received excellent ratings.

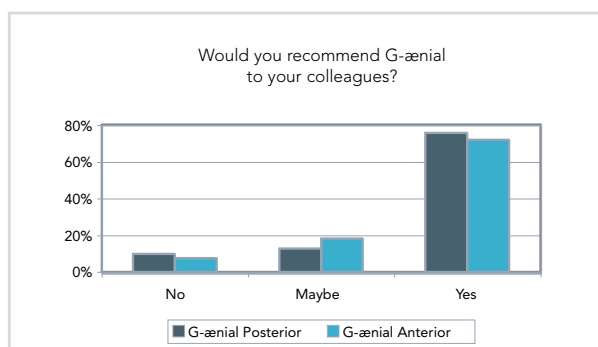


For G-ænial Anterior, 69% of dentists judged the material to be slightly better and 27% better than their current composite; for G-ænial Posterior, 33% of dentists found it to be slightly better and 31% better. Only 10 to 14% rated it as slightly worse to worse.

Easier handling, colour match and radiopacity were quoted as the main reason for preferring G-ænial to their current composite material



72% to 74% of dentists would recommend G-ænial to their colleagues for the characteristics mentioned above, namely, the excellent aesthetics, easy handling and reliable end results.



## 8.0 Literature

### Light diffusion property of newly developed composite resin "G-ænial"

**K. HIRANO, F. FUSEJIMA, T. KUMAGAI, and T. SAKUMA, GC Corporation, Tokyo, Japan**

**Abstract 3019, Genera session IADR 2010, Barcelona**

**Objectives:** Human teeth have unique light diffusion property which creates special colour property. Light diffusion property of composite resin is important to provide excellent aesthetic result on direct composite resin restorations. We developed new composite resin "G-ænial" which has excellent esthetic property and radiopacity. The aim of this study was to evaluate and compare the light diffusion property of human teeth (dentin), newly developed composite resin "G-ænial" and various composite resins.

**Methods:** Human teeth and five composite resins [G-ænial (GN, GC Corporation), Herculite XRV Ultra (HU, Kerr Corporation), PREMISE (PR, Kerr Corporation), Venus (VE, Heraeus Kulzer GmbH) and Esthet. X HD (EH, Dentsply)] were examined. Human teeth (dentin) specimen was prepared by slicing and polishing to form 0.5mm in thick. Disk specimens 0.5 mm thick were prepared from each composite resin. LED curing light (G-Light, GC) was used for curing composite resin specimens. The light diffusion property was measured as diffusive light transmittance distribution through specimen by Goniophotometer (GP-200, MURAKAMI COLOUR RESERCH LABORATORY Corporation) and evaluated for Haze that is calculated from the ratio of diffusive light transmittance to total light transmittance. Statistical analysis was performed using one-way ANOVA (p-value<0.01).

**Results:** Mean values of Haze including standard deviations were shown as follows; (tests per material; n=3).

	Haze (%)
Human Dentin	97.2(0.7)
GN	95.6(0.1)
HU	58.9(0.4)
PR	66.8(0.2)
VE	60.2(0.5)
EH	46.9(0.4)

There is no significant difference on Haze between Human dentin and GN. However, Haze for other composite resins except GN were significantly lower than Human dentin.

**Conclusion:** Haze of G-ænial was higher than those of other composite resins and similar to that of Human dentin. These results suggested that G-ænial can provide esthetic result similar to natural teeth on direct composite restorations.

## 9.0 Instruction for use

### LIGHT-CURED COMPOSITE RESTORATIVE

For use only by a dental professional in the recommended indications.

### RECOMMENDED INDICATIONS

#### A. G-ænial ANTERIOR

1. Direct restorative for Class III, IV, V cavities.
2. Direct restorative for wedge-shaped defects and root surface cavities.
3. Direct restorative for veneers and diastema closure.

#### B. G-ænial POSTERIOR

1. Direct restorative for Class I and II cavities.

### CONTRAINDICATIONS

1. Pulp capping.
2. In rare cases the product may cause sensitivity in some people. If any such reactions are experienced, discontinue the use of the product and refer to a physician.

### DIRECTIONS FOR USE

#### 1. Shade Selection

Clean the tooth with pumice and water. Shade selection should be made prior to isolation. Select the appropriate G-ænial shades by referring to the G-ænial shade guide.

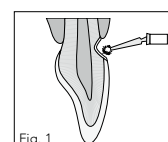
#### 2. Cavity Preparation

Prepare cavity using standard techniques. Dry by gently blowing with oil free air.

Note : For pulp capping, use calcium hydroxide.

#### 3. Bonding Treatment

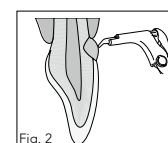
For bonding G-ænial to enamel and / or dentin, use a light-cured bonding system such as GC G-BOND™, GC Fuji BOND LC or GC UniFil® Bond (Fig. 1). Follow manufacturer's instructions.



#### 4. Placement of G-ænial

##### 1. Dispensing from a Unitip

Insert the G-ænial Unitip into the Unitip APPLIER or equivalent. Remove the cap and extrude material directly into the prepared cavity. Use steady pressure (Fig. 2).



2). Maintain pressure on the applicator handle while removing the Unitip APPLIER and Unitip from the mouth. This prevents the Unitip from coming loose from the applicator.

##### 2 Dispensing from a syringe

Remove syringe cap and dispense material onto a mixing pad. Place the material into the cavity using a suitable placement instrument. After dispensing, screw syringe plunger anticlockwise by a half to full turn to release residual pressure inside the syringe. Replace cap immediately after use.

Note :

1. Basically, material can be applied in a single layer to achieve aesthetic restorations using Standard shades. For details, refer to the Clinical Hints.
2. Material may be hard to extrude immediately after removing from cold storage. Prior to use, leave to stand for a few minutes at normal room temperature.
3. After dispensing, avoid too long exposure to ambient light. Ambient light can shorten the manipulation time.

## Clinical Hints

### 1. Anterior cavities

#### a. In the case of small cavities

Restore using a one shade layering technique. In most cases the use of one Standard shade alone will be sufficient. In cases where a higher degree of translucency is needed, one of the Outside special shades can be selected. See also Examples of Clinical applications.

#### b. In the case of large cavities

In most cases a multi shade layering technique will give the best aesthetic results. To block out shine throughs from the oral cavity or to mask discoloured dentin, select an appropriate Inside special shade and continue to build up with a Standard shade. To make a restoration more life like e.g. to copy age related changes in appearance, the final layer should consist of an Outside special shade. See also Examples of Clinical Applications and / or consult the Shade Combination Chart.

### 2. Posterior cavities

#### a. In the case of small cavities

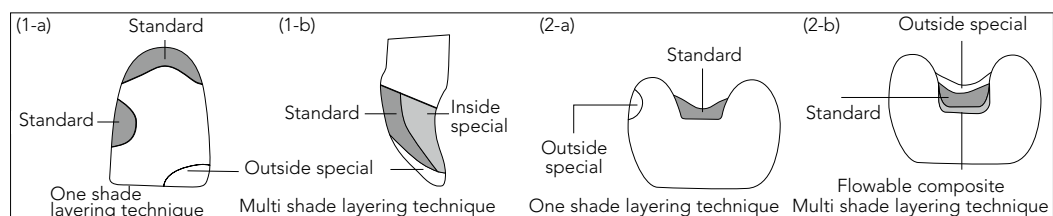
Restore using a one shade layering technique. In most cases the use of one Standard shade alone will be sufficient. In cases where a higher translucency is needed, one of the Outside special shades can be selected. See also Examples of Clinical Applications.

#### b. In the case of deep cavities

Place a flowable composite such as G-ænial Flo or G-ænial Universal Flo on the cavity floor. Then place a Standard shade. For optimal aesthetics use an Outside special shade as the final composite layer. See also Examples of clinical applications.

\*GC Fuji LINING® PASTE PAK, GC Fuji LINING® LC or GC Fuji IX GP can also be used as a liner or base material. Follow the respective manufacturer's instructions for use.

### Examples of Clinical Applications (Clinical Hint No.1, 2)



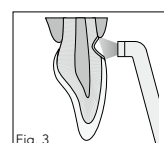
### Shade combination chart for multiple layers in large cavities of anterior teeth (1-b)

	A1	A2	A3	A3.5	A4	B1	B2	B3	C3
Inside special	BW	AO2	AO3	AO3	AO4	BW	AO2	AO3	AO4
Standard	A1	A2	A3	A3.5	A4	B1	B2	B3	C3
Outside special	JE	AE	AE	AE	AE	JE	JE	AE	AE

For details of shades, refer to the following section of SHADES.

## 5. Contouring before Light Curing

Contour using standard techniques.



## 6. Light Curing

Light cure G-ænial using a light curing unit (Fig. 3). Keep light guide as close as possible to the surface. Refer to the following chart for Irradiation Time and Effective Depth of Cure.

Table 7: G-ænial Anterior: Irradiation time and effective depth of cure

Irradiation time		
Plasma arc (2000 mW/cm <sup>2</sup> )	3 sec.	6 sec.
GC G-Light (1200 mW/cm <sup>2</sup> )	10 sec.	20 sec.
Halogen / LED (700 mW/cm <sup>2</sup> )	20 sec.	40 sec.
Shade		
TE, IE, JE, SE, CVE	3.0 mm	3.5 mm
A1, A2, B1, B2, XBW, BW, AE	2.5 mm	3.0 mm
A3, B3	2.0 mm	3.0 mm
A3.5, A4, C3, AO2, AO3, AO4, CV, CVD	1.5 mm	2.5 mm

Table 8: G-ænial Posterior: Irradiation time and effective depth of cure

Irradiation time		
Plasma arc (2000 mW/cm <sup>2</sup> )	3 sec.	6 sec.
GC G-Light (1200 mW/cm <sup>2</sup> )	10 sec.	20 sec.
Halogen / LED (700 mW/cm <sup>2</sup> )	20 sec.	40 sec.
Shade		
P-A1, P-A2, P-JE, P-IE	2.5 mm	3.0 mm
P-A3, P-A3.5	2.0 mm	3.0 mm

Note :

1. Material should be placed and light cured in layers. For maximum layer thickness, please consult the tables.
2. Lower light intensity may cause insufficient curing or discoloration of the material.

## 7. Finishing and Polishing

Finish and polish using diamond burs, polishing points and discs. To obtain a high gloss, polishing pastes can be used.

## STORAGE

Store in a cool and dark place (4 – 25°C / 39.2 – 77.0°F) away from high temperatures or direct sunlight. (Shelf life: 3 years from date of manufacture)

## CAUTION

1. In case of contact with oral tissue or skin, remove immediately with cotton or a sponge soaked in alcohol. Flush with water.
2. In case of contact with eyes, flush immediately with water and seek medical attention.
3. Take care to avoid ingestion of the material.
4. Wear plastic or rubber gloves during operation to avoid direct contact with air inhibited resin layers in order to prevent possible sensitivity.
5. For infection control reasons, Unitips are for single use only.
6. Wear protective eye glasses during light curing.
7. When polishing the polymerised material, use a dust collector and wear a dust mask to avoid inhalation of cutting dust.
8. Do not mix with other similar products.
9. Avoid getting material on clothing.
10. In case of contact with unintended areas of tooth or prosthetic appliances, remove with instrument, sponge or cotton pellet before light curing.
11. Do not use G-ænial in combination with eugenol containing materials as eugenol may hinder G-ænial from setting.
12. All shades except for the outside special shade TE are radiopaque.

## 10.0 Packaging

### SHADES

#### 1. 22 shades for anteriors

Standard shades: XBW (Extra Bleaching White), BW (Bleaching White), A1, A2, A3, A3.5, A4, B1, B2, B3, C3, CV (Cervical), CVD (Cervical Dark)

Inside special shades : AO2, AO3, AO4

Outside special shades: JE (Junior), AE (Adult), SE (Senior), TE (Translucent), IE (Incisal), CVE (Cervical)

\*1 TE shade is not radiopaque.

#### 2. 6 shades for posteriors

Standard shades: P-A1, P-A2, P-A3, P-A3.5,

Outside special shades: P-JE (Junior), P-IE (Incisal)

Note:

A, B, C, AO shades are based on Vita® shade.

Vita® is a registered trademark of Vita Zahnfabrik, Bad Säckingen, Germany.

### SYRINGES

#### 1. Quick start kit

7 syringes (1 each in 7 anterior shades: A1, A2, A3, B2, AE, IE, JE) (2.7 mL per syringe)

Shade guide

#### 2. Advanced kit

7 syringes (1 each in 7 anterior shades: A3.5, AO2, AO3, B1, B3, C3, TE) (2.7 mL per syringe)

#### 3. Refill

1 syringe (available in 28 shades) (2.7 mL per syringe)

Note:

Weight per syringe: 4.7 g for anterior syringes, 5.5 g for posterior syringes

### UNITIPS

#### 1. Quick Start Kit

35 tips (5 tips each in 7 anterior shades: A1, A2, A3, B2, AE, IE, JE) (0.16 mL per tip)

Shade guide

#### 2. Advanced kit

35 unitips (5 tips each in 7 anterior shades: A3.5, AO2, AO3, B1, B3, C3, TE)

#### 3. Refill

a. Pack of 20 tips (packs available in one of 14 shades) (0.16 mL per tip)

(8 anterior shades -A1, A2, A3, A3.5, AO3, CV, IE, AE)

(6 posterior shades-P-A1, P-A2, P-A3, P-A3.5, P-JE, P-IE)

b. Pack of 10 tips (packs available in one of 14 shades) (0.16 mL per tip)

(14 anterior shades - XBW, BW, A4, B1, B2, B3, C3, AO2, AO4, CVD, TE, JE,SE,CVE)

Note:

Weight per Unitip: 0.28g for anterior tip, 0.33g for posterior tip

### ACCESSORIES

#### 1. Unitip Applier

#### 2. G-ænial Shade Guide

#### 3. Mixing pad (No.14B)











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