



Graphenano
DENTAL

G-CAM

Graphene reinforced
biopolymer disc
for CAD/CAM milling.

For definitive prosthesis.



graphenanodental.com

G-CAM





Graphenano Dental believes in the use of biopolymers reinforced with graphene to produce dental prostheses by milling with CAD/CAM technology.

The **graphene reinforced biopolymer G-CAM** disc, especially designed for creating dental prostheses, is available in different chromatic colours that have a natural aesthetic appearance.

Graphenano Dental belongs to Graphenano, a group of companies dedicated to the integration of graphene for multiple uses, and a leader in the production of different types of nanostructures on industrial scale.



Polymer + Graphene

Thermal-curing resin

Acrylic resins are hard, fragile and crystalline polymers.

Thermal-curing resins with a Poly (methyl methacrylate) are the most used type of material in dental laboratories. However, they have a low impact, transverse and flexion resistance. Therefore, these resins are susceptible to cracking when subjected to mechanical forces.

Polymer with graphene

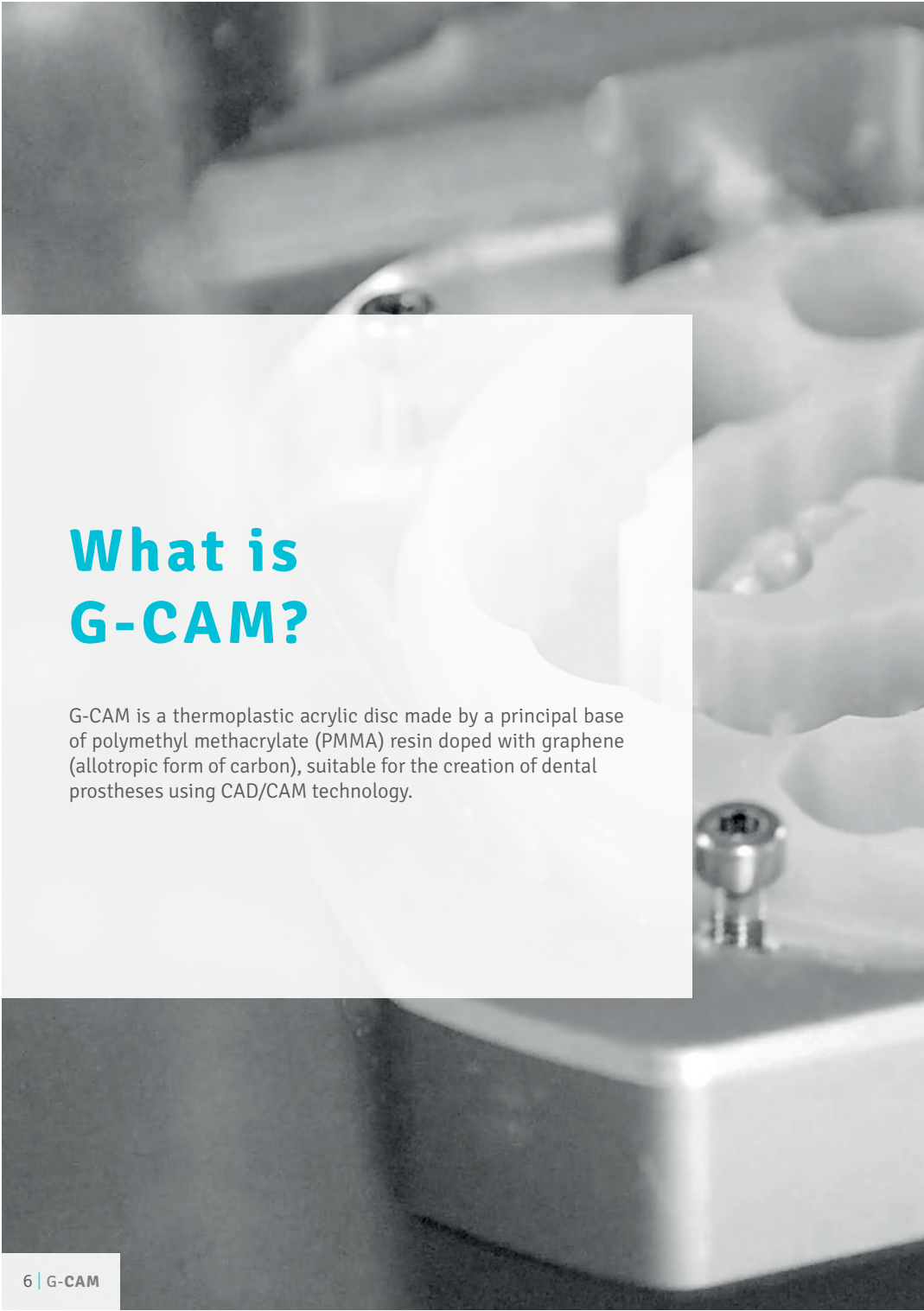
Graphene is a single graphite layer, consisting of a hexagonally arranged, sp^2 bonded, stable two-dimensional allotrope of carbon with a plethora of unique properties (Geim and Novoselov, 2004).

Amongst its main properties are great thermal and electrical conductivity, high traction resistance, small density and low coefficient of thermal expansion. Due to these properties, graphene has become an excellent material with big potential for the improvement of industrial applications.

The incorporation of graphene into polymers is an innovating strategy to improve its mechanical properties. The increase on the elastic modulus as well as the toughness reduce the appearance of cracks and breaks. The low density of graphene in addition to the excellent mechanical properties lead to the creation of lighthard polymers.

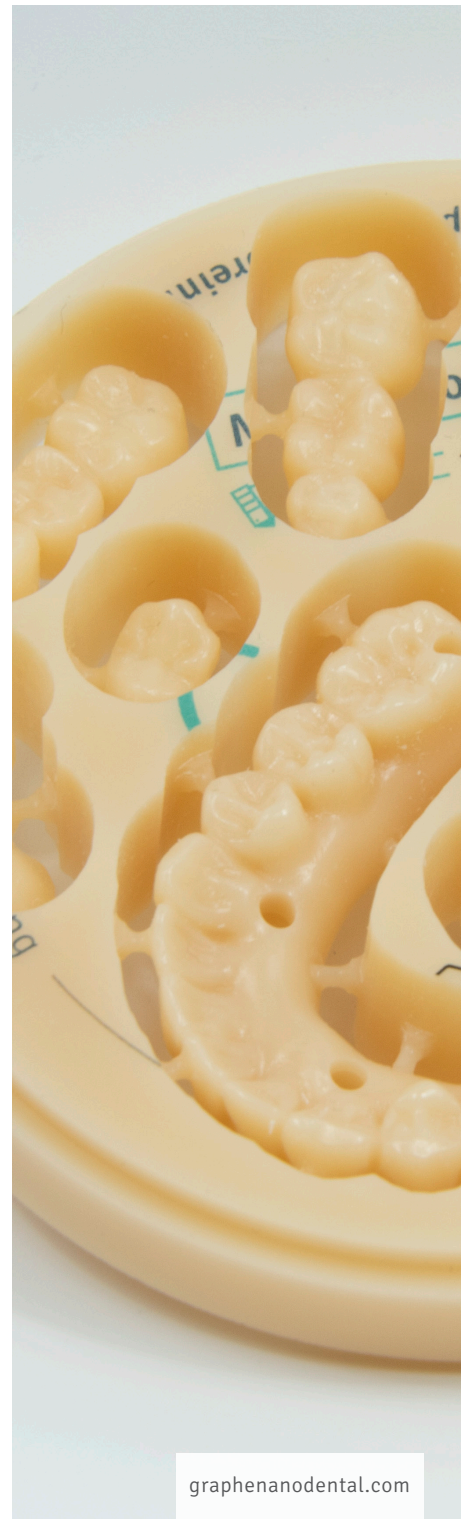
Therefore, graphene is an ideal candidate to improve the performance of thermal-curing acrylic resins for dental use, not only to create polymers with high mechanical resistance, but also polymers with low water absorption capacity, with minimum residual monomers and biocompatible.

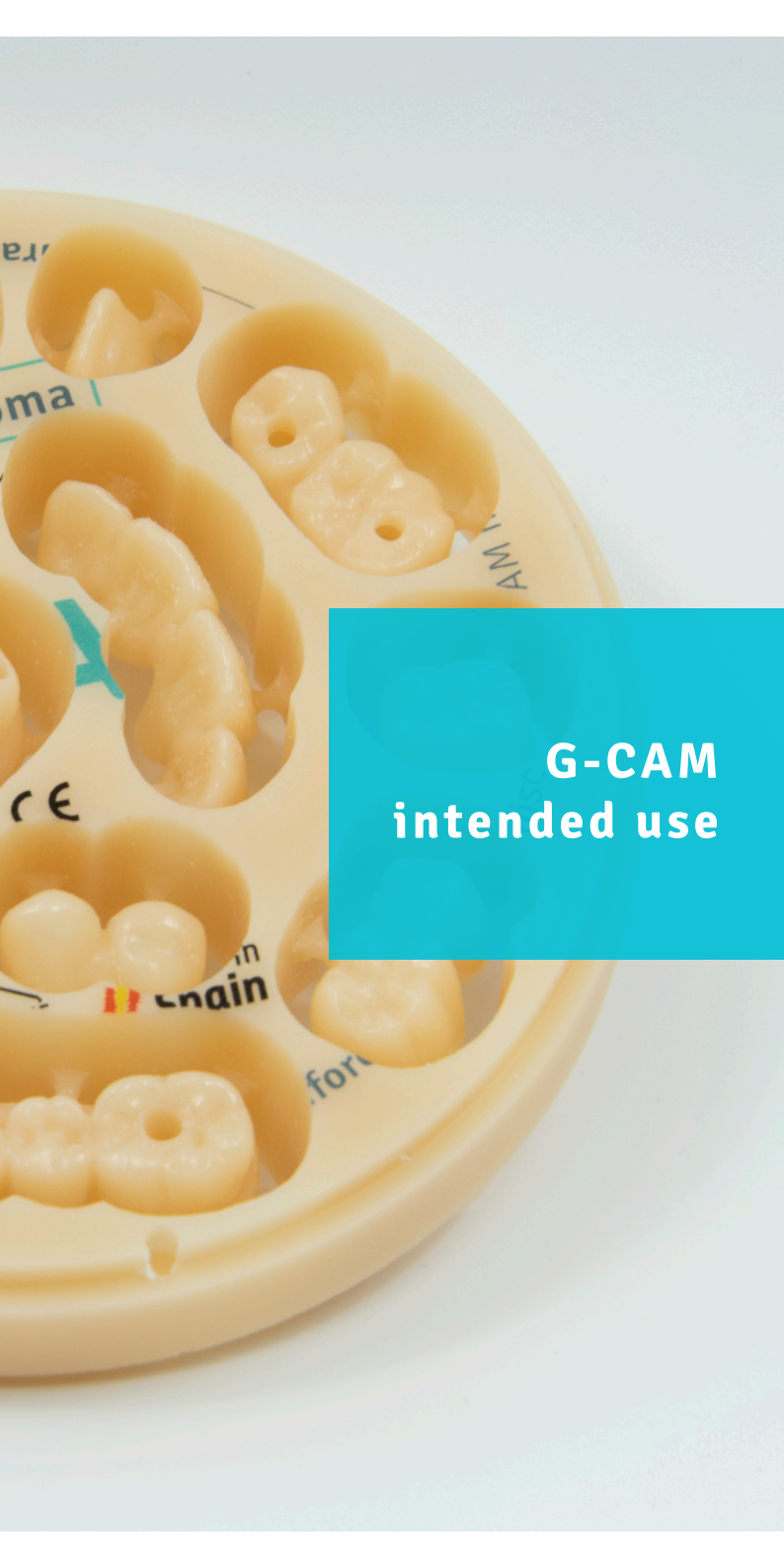




What is G-CAM?

G-CAM is a thermoplastic acrylic disc made by a principal base of polymethyl methacrylate (PMMA) resin doped with graphene (allotropic form of carbon), suitable for the creation of dental prostheses using CAD/CAM technology.





G-CAM intended use

G-CAM discs are intended to be used for the manufacture of full and partial removable dentures, implant overdentures, as well as permanent and temporary restorations such as anterior or posterior crowns and bridges, inlays, onlays, veneers, copings and substructures.

- G-CAM, polymethyl methacrylate (PMMA) doped with graphene, is manufactured using the heat-curing method.
- G-CAM presents high modulus and elastic limit to ensure that the tensions generated during biting and chewing do not cause permanent deformations, and it is possible to manufacture prosthesis of smaller sections.
- G-CAM presents high deformation resistance and stress limit, thus avoiding the formation of cracks and fractures.
- G-CAM is low density making the prosthesis lightweight.
- G-CAM increases the material hardness comparing with acrylic resins used in dentistry.
- G-CAM final appearance is similar to oral tissue. Thus ideal for visible areas.
- G-CAM has colour stability.
- G-CAM has wide chromatic range, even within the same piece, making it look extremely natural.

Mechanical properties



- G-CAM disc is chemically inert.

- G-CAM water absorption is $4 \mu\text{g}/\text{mm}^3$ and a solubility of $0.5 \mu\text{g}/\text{mm}^2$. The release of residual monomer is minimum, with a percentage of 0.004% of residual monomer.

Thanks to these physical properties G-CAM offers a durable and safety treatment.



Chemical properties



Biological properties

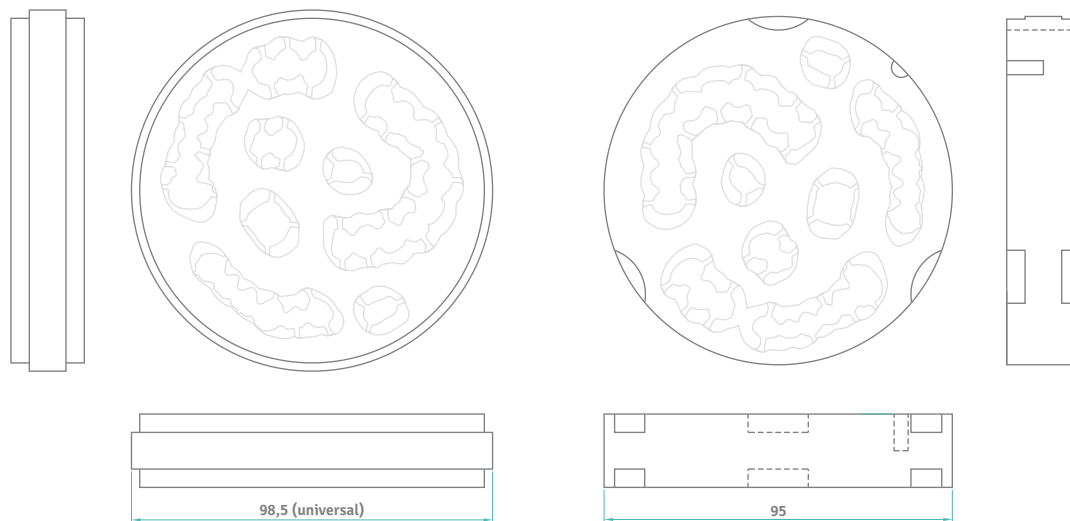
- The G-CAM disc is a biocompatible device according to the indicated test within:

- ISO 7405:2018 “Evaluation of biocompatibility of medical devices used in dentistry”
- ISO 10993-1:2018 “Biological evaluation of medical devices”

- G-CAM has passed the cytotoxicity, hypersensitivity, irritation or intracutaneous reactivity, acute systemic toxicity, subchronic systemic toxicity, genotoxicity and implantation tests carried out at the University of Alcalá and by the Valencian Institute of Microbiology (IVAMI).

The results showed no adverse biological effects in any of the tested items showing adequate biological performance in all cases.

G-CAM Formats



Anchorage 98,5 mm (universal)

Anchorage 95 mm

G-CAM is presented as a compacted resin disc offered in two different anchor dimensions. Depending on the anchor to the CAM device the discs are considered with different variant names:

- **Anchorage 98,5 mm (Universal):** disc of 95mm diameter. Thicknesses: 14, 16, 18, 20, 22, 24, 26, 30 mm.
- **Anchorage 95 mm:** disc of 98.5mm diameter. Thicknesses: 14, 16, 20 y 24 mm.

Material properties

Elastic modulus ⁽¹⁾:
3200 ± 7% MPa

Bending strength ⁽¹⁾:
140 ± 7% MPa

Water absorption ⁽¹⁾:
4 µg/mm³

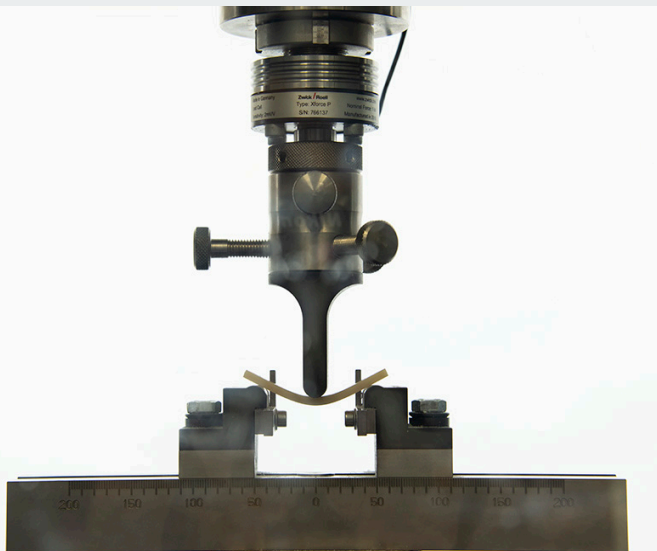
Solubility ⁽¹⁾:
0,5 µg/mm³

Compressive strength ⁽¹⁾:
155 ± 5 MPa

Residual monomer ⁽¹⁾:
<0,004 %

Surface hardness:
88 ShoreD ⁽²⁾
19.5 KHN ⁽³⁾

⁽¹⁾ ISO 20795-1: 2013 | ⁽²⁾ ISO 48-4:2018 | ⁽³⁾ ASTM E384 ⁽⁴⁾ ISO 5833:2002



G-CAM disc is available in two different formats: Monochroma and Multichroma discs may be both used for anatomical monolithic restorations. When machined, G-CAM Multichroma and G-CAM Monochroma present a different visual effect:

- **G-CAM Monochroma**, is made of a pure VITA Classic guide's colour.
- **G-CAM Multichroma**, it has a chromatic spectrum based in natural colour imitating the optical effects of the natural dentition.

G-CAM device is available in the following colours: BL1, BL2, A1, A2, A3, A3'5, B1, B2, C2 and Transparent (according to VITA classic guide).



* The shade of the colour in the catalogue may differ from the actual colour.

Comparison of dental solutions





Types of prostheses / material	PMMA	Metal	Zirconium	Lithium disilicate	Resin + graphene
Individual crowns					
Bridges of up to 3 pieces	-			-	
Bridges of more than 2 implants	-		-	-	
Settings		-	-		
Veneers	-	-			
Complete prostheses		-	-	-	
Implants overdentures		-	-	-	

What is Multichroma format?

Multichroma format shall not be mistaken with the multilayer format.

Multichroma format is a new concept created by Graphenano Dental in which the transmission of background colours of dental restorations is simplified with the intention of achieving the naturalness of the restorations, imitating optical effects of natural teeth.

The regular version that the sector offers is a multilayer format of horizontal setup. This format generates “band effects” of transition between layers, which worsen in situations of non-harmonic anterior groups and in speed curves of posterior sectors. By contrast, the configuration of natural structures is

vertical, hence the depth and thicknesses create multichromatic light effects. In other words, the solution offered by dental sector is a horizontal colours configuration, while the nature of the tooth is vertical.

As it would be very difficult to obtain an arrangement of vertical layers in a disc format for multiple unit restorations, Graphenano Dental achieves these natural effects through the control of thicknesses with single-layer translucent colours. When the tooth is out of the mouth, the most translucent area is the cervical edge (**Image 1**); but, when the tooth is adapted onto the model, the chroma is enhanced in the cervical area and the most translucent area is now the incisal edge, in the same way as in a natural setup (**Image 2**).



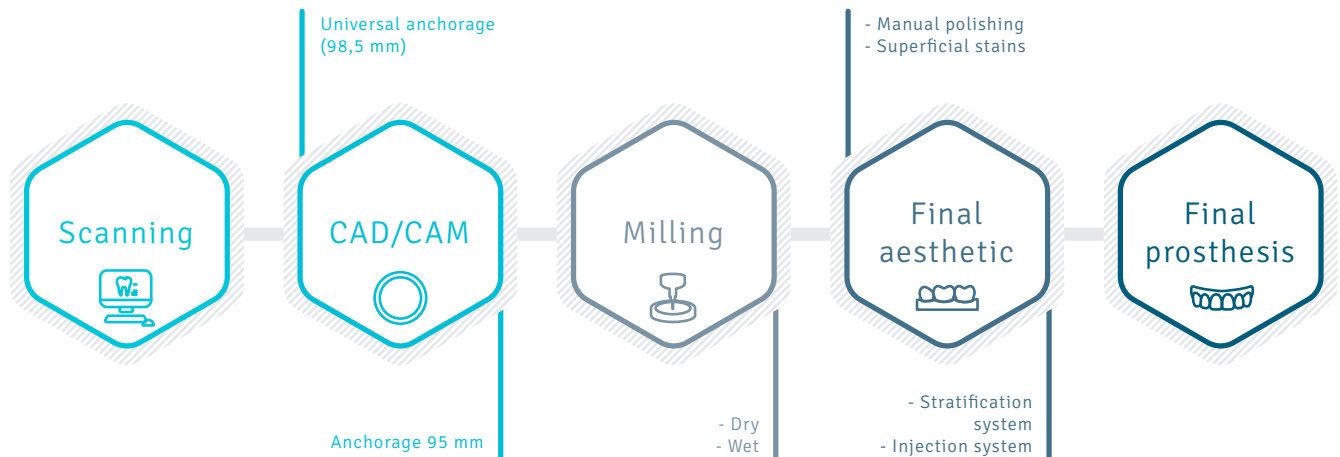
(Image 1)



(Image 2)

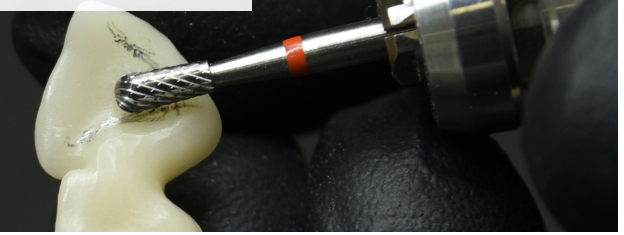
Process in laboratory G-CAM

Graphenano Dental, dedicated to the development of graphene discs for CAD/CAM, is committed to delivering the best dental solution to prostheses' patients worldwide, guaranteeing them more aesthetic, comfortable and durable smile, by using the most advanced technology (graphene nanotechnology) together with efforts of dental experts, technicians and dentists.



- G-CAM specific design parameters in ExoCad software.
- G-CAM milling strategy for Millbox CAM software.

G-CAM Work Process



Process in laboratories

Minimal thickness for crowns

Review all the G-CAM design parameters establish for all the different dental treatments



Cleaning the graphene crown



Sandblast with
aluminum oxide



Clean with
alcohol



Dry with
pressured air

Process in clinic

G-CAM structure preparation



Sandblast with aluminum oxide



Remove the excess with air



Clean with alcohol and let dry (60 s)



Apply a thin layer of acrylic primer and light curing

Tooth preparation



Clean and isolate the tooth with a rubber dam



Acid etching (at 37% of phosphoric acid)



Rinse thoroughly with water and dry



Apply the primer and light curing

Cementation of the crown



Apply dual cement



Firmly press and remove the excess of cement



Polymerize and remove the excess of cement

* The cement we recommend is resin-based and dual-format and read the instruction sheet of the material to be used for cementation, each cement may need a specific protocol.



G-CAM

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The registration of Graphenano dental and G-CAM in USA may be check under the FDA's Establishment Registration & Device Listing page.

<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfRL/rl.cfm>