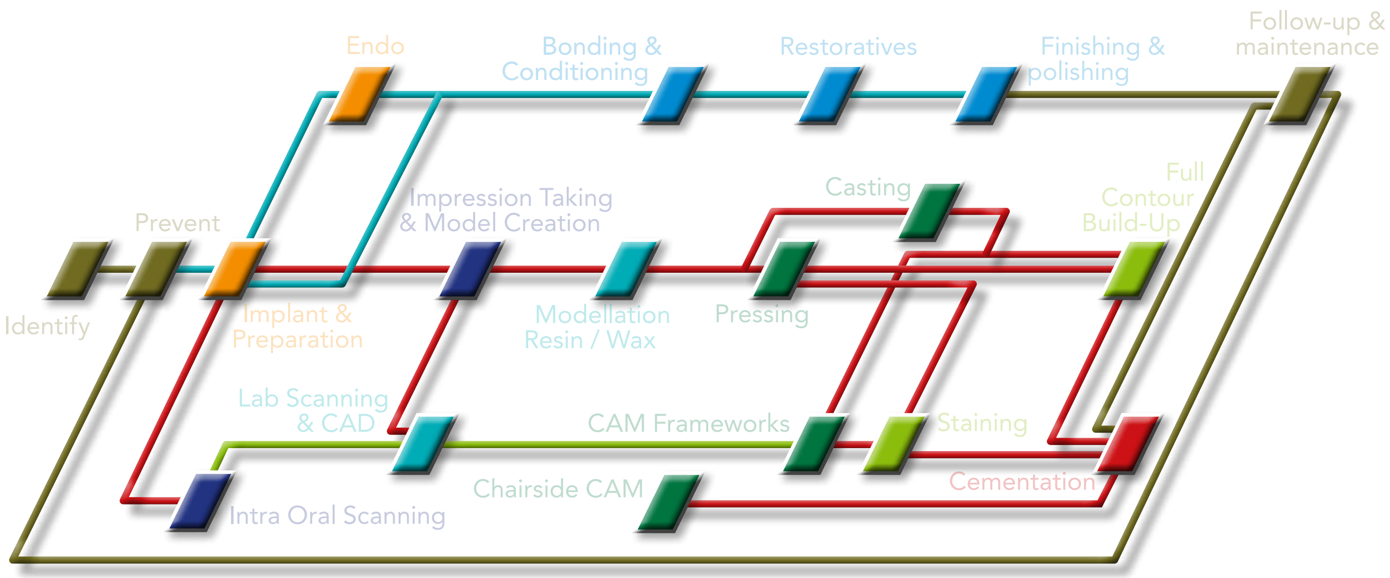
GC get connected 10

Your product and innovation update

2018

Contents

Welcome to GC 'get connected', GC Europe's newsletter that showcases our latest product innovations, techniques and trends in restorative dentistry.



Dear readers

Welcome to the 10th edition of GC's Get Connected newsletter.

Dear reader,
Welcome to the first edition of GC Get Connected for 2018. Another fiscal year is coming to a close at GC, and what a year it has been! Our new markets grew in number and in size. Our existing markets expanded and last, but not least, the number of associates in our subsidiaries has increased. Thank you so much for all the trust you put in us!

To ease your navigation across the whole range of GC products, we designed a brand new and interactive catalogue. Its 88 pages are packed with information about products' main indications, links to video tutorials, apps and ordering information. It's available in five languages – English, German, French, Italian and Spanish, and can be found on www.gceurope.com/products/catalogue.

When it comes to GC's new products, I would like to start with G-ænial Universal Injectable – our high-strength injectable light-cured restorative composite. With it even the most inaccessible areas can be filled without voids due to the bendable dispensing tip which can reach the bottom of any cavity. It's the perfect answer for safe and durable restorations. I also have to mention the extensions to our Labaratory portfolio: Initial Spectrum Stains, Initial IQ One Body Lustre Paste NF Effect Shades and Initial Enamel Opal Boosters. All designed keeping the needs and requirements of our customer in mind. And of course GC Modeling Liquid, created to model composite materials for direct restorations. Applied with a brush, it helps to achieve perfect morphology and smooth finish.

There are more news from across all our divisions, but I'd like to focus your attention on the innovations happening in our digital department. Our team has been working hard on adapting the line to fit the trends in dentistry. We expect to see many new things coming from this direction, so stay tuned.

Furthermore, our Milling centre located in Leuven, Belgium is going from strength to strength. Three new associates have been added to the team. The machine park, consisting of the well-known Matsuura is now backed-up by a DMG industrial machine. Our warranty has been extended to 5 years for all ceramic and resin-based constructions, 10 years for all metal-based constructions and lifetime for Aadva implants. In short, GC's advanced CAD/CAM Production Centre offers solutions for the most elaborate cases.

I hope you enjoy this issue of GC Get Connected and do let us know if there are any topics you'd like us to cover in the future.

Michele Puttini
President, GC Europe

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initial
LiSi Press

Initial™ LiSi Press for all ceramic restorations on discoloured preps

By **MDT Stefan M. Roozen**, Austria

MDT Stefan M. Roozen
Zell am See / Austria

Stefan Roozen was born in Tyrol in 1980. In 1995 he began his training as a dental technician, graduating in 1999 in Salzburg. Since then he attended numerous training courses at home and abroad. In 2001 he started at Pils Zahn-technik GmbH where he still works today as laboratory manager and deputy of the management. In 2002, he attended the master school in Baden / Vienna, where he graduated in 2003 as a master. His main areas of work are complex prosthetic reconstruction (tooth and implant supported), demanding restorations in the aesthetic and functional area. He is the author of several international publications, external speaker at the Austrian master school, speaker and co-speaker at international course and congress events focusing on fixed reconstructions, Ceramic, implantology, prosthetics and CAD-CAM.

Lithium disilicate offers us exceptional possibilities for the fabrication of natural looking dentures.
In addition to its high degree of stability, the ability of this material to transmit light is what makes it so valuable. The ceramic shoulder on conventional metal ceramic crowns is a good example of the enormous aesthetic gains that can be obtained by increasing light transmission. For example, lithium disilicate exhibits positive cosmetic results, even when applied monolithically, as is done with fully anatomical restorations, particularly in the posterior region.

GC Initial LiSi veneering ceramic is optimal for refining or veneering in the anterior region. The cutback technique offers a good combination of stability and high aesthetic value for this. The crown's fully anatomical design, pressed with MT (Medium Translucency), slight vestibular reduction, lustre pastes and minimal GC Initial LiSi veneering ceramic overlays, is highly efficient. The use of these variants allows the underlying tooth substance to remain a cosmetic part of the crown without being covered by a light-blocking framework. However, the stumps must not be strongly discoloured.

Medium Opacity (MO) frameworks are generally used to compensate for dark substrates. However, this opaque compact must be covered with veneering ceramics and cannot be fully contoured.

The following case study describes the procedure for an all ceramic restoration with GC Initial LiSi Press (a lithium disilicate glass ceramic) on a strongly discoloured prep.

Initial™ LiSi Press
for all ceramic restorations
on discoloured preps

The initial situation

The young patient complained about the aesthetically unpleasant appearance of her Zr crown 21.
The previous restoration did not match the shape and colour, and the cervical area in particular seems too opaque. A common phenomenon with zirconia is the unnatural emission of the material into the marginal gingiva.

Fig. 1: The previous Zr crown on 21.

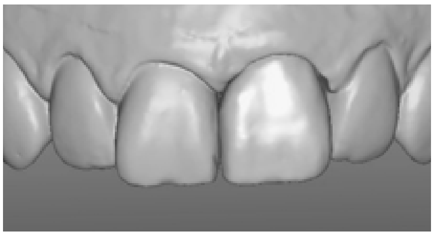
Fig. 2: The dark prep became visible after the crown was removed.

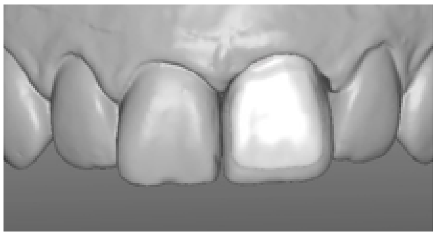
In this case, the degree to which the gingiva in the cervical areas of the natural teeth exhibited a reddish radiation was particularly visible. Little consideration was given to this effect with the previous restoration.

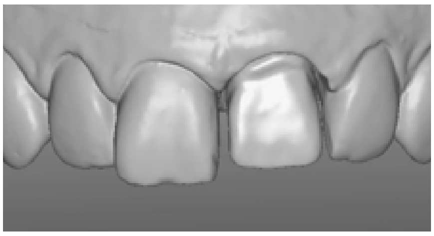
Fig. 3a: Red colouration in the cervical area of natural tooth 11 (compare with colour pattern A1).

Fabrication of the framework

Fig. 4: Production of the wax cap with CAD/CAM.







The crown was removed, prepared once again and moulded. After the model was created, the wax cap was fabricated using CAD/CAM.

The object was pinned according to procedure. Additional air channels were installed to prevent air compression in the marginal area and, therefore, potential inaccuracies in the subsequent pressing result. The surface was sprayed with SR Liquid and then invested with LiSi PressVest (fig 5). After a setting time of approximately 20 minutes, the muffle was placed in the preheating oven. The higher the temperature to which the phosphate-bonded investment is heated, the higher the compressive strength it develops. Therefore, the initial oven temperature was 900°C and was lowered to 850°C after the muffle was inserted.

It is important to install the investment using the fast heating process, as this leads to a relatively constant expansion. This is because, among other things, conventional slow heating leads first to expansion (cristobalite transformation at approx. 250°C) and then to contraction (due to the decomposition of ammonium phosphate at approx. 350°C). The repeated expansion and contraction of the material thus promotes the formation of small cracks.

The shade selected for the pressing material was ingot MO0; this selection was based on the contrast between the black discolouration of the stump and the light target colour. This is perfect for the layering technique with high fluorescence and a high brightness value. It has an excellent covering capacity due to its relatively high opacity.

After pressing and cooling, the object was blasted with glass beads. GC Initial LiSi Press has almost no reaction layer; therefore, the need for acidification is eliminated. The result is a very homogeneous surface with an excellent fit (fig. 7& 9).

Fig. 5: The prepared wax object for investing with LiSi PressVest (according to the method of Toshio Morimoto, Osaka).

The ability of this material to reproduce a natural fluorescence is unique and adding extra fluorescense is not a prerequisite as it is the case with other framematerials. This yields restorations that are true to the natural model, wherein the fluorescence comes from deep inside the restoration (fig 8).

Fig. 6: GC Initial LiSi Press, with a flexural strength of > 500 MPa.

Fig. 7: The pressing gives a homogeneous result, and barely any reaction layer is formed.

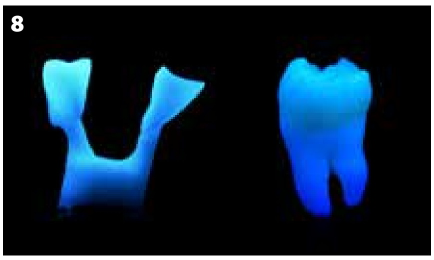


Fig. 8: The MO0 ingot exhibits very good fluorescence.

Fig. 9: Perfect edge fit of the pressed cap.

Wash firing

Fig. 10: We were able to cover the dark tooth prep with a cap thickness of approx. 0.9mm.

Fig. 11: The natural white framework on the working model.

Fig.12: Colouring and adjusting the colour with GC Initial Lustre Pastes NF.

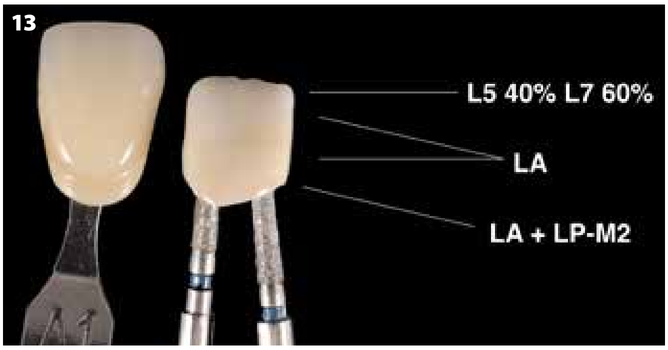


Fig. 13: Lustre with L-A: more depth effect was created in the incisal area with "violet"; the red value in the cervical area was increased by adding the LP-M2 (gum).

GC Initial Lustre Pastes NF were applied to the bare, white cap to adjust its base colour (fig 12).
For this purpose, we used L-N, a light lustre coating with L-A; in the incisal area, we used a mixture of L-5 and L-7. The redness in the cervical area was increased with LP-M2 to mimic the previously described radiation into the surrounding gingiva. It was important to allow only a slight hint of the actual colour, and not with too much intensity (fig 13). After firing in the oven, Glaze Liquid was applied once again and sprinkled with an FD-91 make-up brush. The excesses were blown off by mouth and burned. The result was a very dynamically active framework with established colour and a scattering of light on the surface (fig 15).

Fig. 14: Thin sprinkling of ceramic powder.

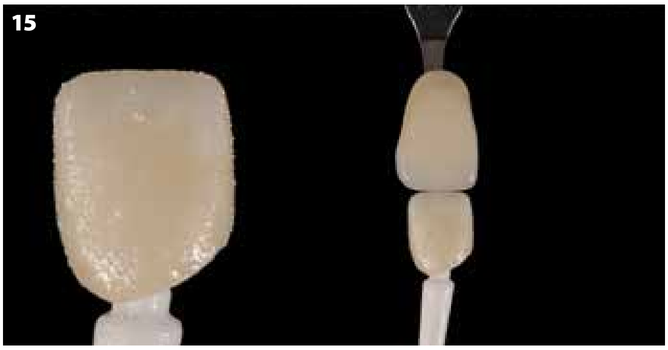


Fig. 15: The result after firing exhibited a dynamic surface with a nice colour.

Ceramic layering

We then proceeded to veneering using GC Initial LiSi veneering ceramic. INside Primary Dentin was used to achieve a relative chromatic effect from deep within the restoration. In this case, an additional 20% of Bleach Dentin was mixed into the IN-44 to increase its brightness slightly. The incisal third was processed with Fluo Dentin FD-91. This was followed by dentin that was mixed with neutral Transpa towards the incisal area to increase the depth effect. A mixture of E-58 and TN was applied to the incisal plate. This was wetted with a little staining liquid to enable the precise placement of the mamelon on it with FD-91. CL-F was thinly layered on the finished internal structure in order to mimic the sclerotic dentin layer. Bluish mesial and distal bands were applied with EOP-3. A subtle horizontal band was applied with EOP-2 to create more brightness. Cervical CT-21 and CT-22. The final shape was fully covered with Enamel E-58 and 25% EOP-2. Finally, to mimic the halo effect, a little more EO-15 was applied incisally. The layering was over-contoured accordingly to compensate for the sinter shrinkage.

Special care had to be taken with the accuracy of the subsequent firing, as the firing window for lithium disilicate is very narrow. In general, no attempt was made to perform repeated firing cycles in order to obtain the best brilliance, colour and translucency.

The final shaping was followed by a soft, short glaze firing in which the surface pores were closed.

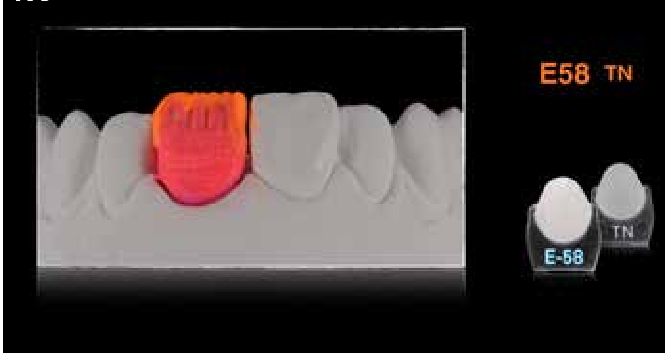
The degree of gloss was determined directly on the patient during the try-in of the crown and produced by mechanical polishing. This additionally solidified the surface and created a natural silk matte effect (fig 18-19-20).

16a


16b


16c


16d


16e


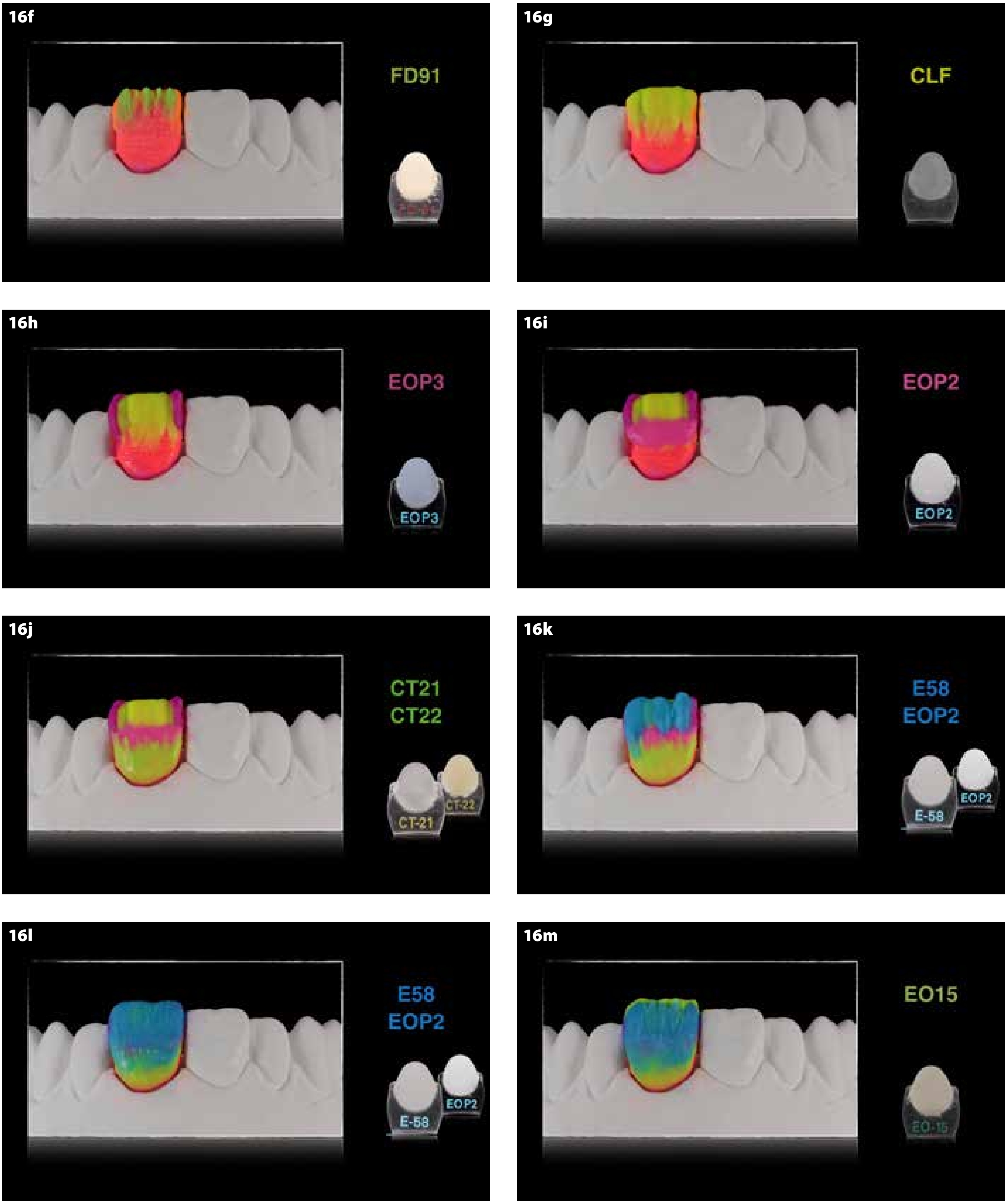


Fig. 16: The steps for layering with GC Initial LiSi veneering ceramic.

Fig. 17: The result after firing.

Fig. 20: The finished crown after glaze firing.

Figs. 18-19: Fitting and surface finishing.

Results and conclusion

After an evaluation and performance check of the restoration in the patient's mouth, some fine-tuning was performed and the crown prepared according to the protocol for cementation. Cementation completed the work process, the goal of which had always been to leave no visible traces of the effort and to achieve a good integration into the natural environment.

Despite the difficult initial situation, the right choice of materials made it possible to meet the patient's high aesthetic standards. The material components were perfectly matched to each other and thus offered a high degree of safety and efficiency in production.

The vitality and natural-looking fluorescence of GC Initital LiSi Press is outstanding. The flow of light through the entire crown into the sulcus area is also appreciable. This lightens it up and prevents grey shadows. The crown appears life-like and natural (fig. 21 & 22).

Figs. 21-22: The final result in the mouth.

Dr. Rosen Venelinov
Dr. Venelinov graduated in 2000 at the Faculty of Dentistry of the Medical University of Plovdiv (Bulgary). He founded Dental Studio Venelinov in 2001. He specialized his practice towards endodontics since 2003 and towards aesthetic dentistry since 2004. Since 2006, he is a member and co-founder of the Bulgarian Endodontics Society and a widely recognized lecturer involved in numerous Bulgarian and international dental fora. Since 2007, he is also a lecturer and opinion leader for the Bulgarian devision of the company GC (Japan) and since 2010 of the company Coltene (Switzerland) for endodontics.
Articles by Dr. Venelinov have been published in many Bulgarian and international publications.
He is involved in the development of composite instruments with one of the reputed manufacturers from the USA - Paradise Dental Technologies. The company produced a kit designed by him: the "Dr.V" composite set.

Dr. Kostadin Gospodinov
He graduated in 2014 at the Medical University of Varna (Bulgary) as Master in Dental Medicine. From 2013 to 2017, he actively participated in the Sofia Dental Meeting. He attends various Master courses on direct and indirect techniques in aesthetic dentistry on a regular basis. His topics of interest include digital dental medicine and CAD/CAM technologies.

Indirect CAD/CAM restorations

from leucite-reinforced glass-ceramics

Case report

By **Dr. R. Venelinov, Dr. K. Gospodinov,** Bulgaria

The selection of materials and techniques for indirect restoration of broken teeth has always been a critical aspect in the planning of a treatment. It is made even more difficult by the fact that there is a myriad of restorative materials, such as composite and ceramics, on the market [(1)]. It is therefore of important to look for a balance in the restoration process between ease of execution, predictability of the end result and treatment cost.

The durability of the restorations is also an important criteria, and then ceramic is often the material of choice. Nowadays, the manufacturers offer a great variety of ceramics (feldspar, glass-ceramics, lithium disilicate), zirconium, hybrid ceramics/composites, etc.

A distinction can also be made between the different fabrication process, using a traditional analogue technique or using a digital path. In the analogue technique, an impression is taken after the preparation of the teeth; the impression is then poured and the dental technician manually creates the final restorations. On the other hand, digital technologies - digital impression, design, milling and customisation - are becoming more and more popular. In the fast-paced life, digital technologies provide us with a comparative ease of execution, predictable end result, high precision, shorter period of execution (saving time and resources for the clinician as well as the patient) and an optimal cost of the end product.

The selection of materials also depends on their properties. Leucite-reinforced glass-ceramics are the perfect choice for restoration of frontal and distal areas without occlusal and para-functional challenges (bruxism, occlusopathies).

Advantages of leucite-type glass-ceramics are their high translucency, beneficial optical/mechanical properties and their wide application range, including dental inlays, onlays, veneers and crowns [2]. Moreover, the easy processing without chipping in the thin areas around the margins, the easy and predictable way of colour customization and polishability make them a logical choice in the clinic.

Case 1 - Partial indirect restorations in the posterior region

Fig. 1: Occlusal view of tooth n°47

Fig. 2: Occlusal view of tooth n°17

Fig. 3: Preparation of tooth n°17

Initial situation

A 19-year-old patient came to our clinic with the request to restore his lower second molar. Tooth №47 was endodontically treated two years ago, whereafter it was restored with composite (Fig. 1). The patient's mother was concerned because the restoration was getting damaged and asked us to restore the tooth in a more stable and durable way. According to the patient, the tooth had been asymptomatic and had not caused any other problems to him in the period following the initial treatment.

The patient brought an X-ray taken 2 weeks before coming to us, clearly showing that the tooth was rotated 180 degrees (the mesial side was turned distally). The apical curvatures of both roots were pointing towards mesial. A broken endodontic instrument (part of a lentulo, 2-3 mm long) was located in the apical part of the mesial root apically from the curvature of the canal and the root canal filling of the distal canal was insufficient. No periapical changes could be seen on the X-ray. Intraoral examination revealed the presence of an old obturation covering two-thirds of the tooth, of which only the distal and the lingual wall and part of the vestibular wall were preserved. Along the boundaries of the composite, there was a brownish discoloration, which is a sign of microleakage. Also, secondary caries was visible on the occlusal surface. There was no occlusal contact of the restoration with the antagonist.

Examination of the antagonists revealed that tooth №17 had dysplastic enamel and a carious lesion on the mesial side. There were no periodontal changes, but it was clearly visible that there was no attached gingiva in the vestibular area and the mucus lining the cheek began distally from the sulcus (Fig. 2). After a discussion with the patient and his mother, we decided to restore the lower molar with a full-ceramic crown. Because of the sharply expressed equator mesially and the very thin wall in that area, the tooth was prepared with a vertical edge as described in the Biological Oriented Preparation Technique (BOPT) by Ignazio Loi. [3] A ceramic onlay, covering only the affected surfaces and cusps, was planned to restore the upper molar (Fig. 3). [4]

Preparation

After placing the rubber dam, the old obturation and the underlaying cement were removed. After removal of all caries, the endodontic cavity was filled with a fibre-reinforced composite (everX Posterior, GC). The core build-up was completely covered with a dual composite core material (Gradia Core, GC) (Figs. 4-7).

Fig. 4: Removal of old restoration - under the composite restoration was a base from zinc phosphate cement

Fig. 5: Post-endodontic cavity, after removing of the old restoration and sandblasting with 27 µm Al_2O_3

Fig. 6: Buildup of the cavity with everX Posterior. We restored 3/4 of the full anatomy depth in few layers, 3-4 mm thickness each.

Fig. 7: It is important to cover everX Posterior with composite. In this situation, Gradia Core was used. Vestibular view of final composite build-up (Gradia Core)

Tooth №47 was prepared according to the technique described by Dr. Ignazio Loi [(4)] and a temporary crown was made. It was left in place for 4 weeks to allow the gingival tissues to recover.
Thereafter, the health condition of the marginal gingiva of tooth №47 was examined during the follow-up consultation (Fig. 8).

Fig. 8: Tooth n°47 prepared according to the Verti Prep Method

Scanning, milling and characterisation

On the day of scanning, the caries of tooth №17 was removed after having given anesthesia (Ubistezin, 3M ESPE), the rubber dam was placed and the tooth was prepared. The preparation included the vestibular, medial, and partially the distal wall (Fig. 9).[5] An occlusal reduction of the vestibular cusps of the tooth was also made to alleviate the dysplasia defects. The dentin was immediately sealed with a bonding agent, to prevent infiltration of microorganisms and colorants into the dentin.[6-9]

Fig. 9: Preparation of tooth n°17

The teeth were scanned and the bite registered with an intraoral scanner (Omnicam, Dentsply Sirona). Virtual models were created in the camera software, and the final design of the constructions was planned (Figs. 10-13). The adjacent teeth and the antagonists were taken into account in the restoration design. At the base, the crown was intentionally thickened to achieve better support of the marginal gingiva to create the emergency profile.[10] The final restorations were milled from leucite reinforced glass-ceramic blocks - Initial LRF block, A1 HT C14 (GC). After milling, the onlay and crown were customized with oxide paints and covered with Initial LRF Glaze Paste (GC) (Fig. 14a).

Fig. 10: CAD - design of the preparation after the scanning of tooth n° 47

Fig. 11: CAD - design of the ceramic restoration of tooth n° 47

Fig. 12: CAD - design of the preparation after the scanning of tooth n° 17

Fig. 13: CAD - design of the ceramic restoration of tooth n° 17

Cementation

During the next visit, both glass-ceramic restorations were prepared for cementation. The internal surfaces were sandblasted with 50 µm aluminium oxide powder and treated with hydrofluoric acid gel (9,5%) for 30 seconds (Fig. 14b).
The gel was thoroughly rinsed off with water spray (Fig. 14c). Thereafter, orthophosphoric acid 35 % was applied for 60 seconds (Fig. 14d).
After rinsing, they were placed in an ultrasound bath with alcohol for 2 minutes. The etched surfaces were treated with silane - G-Multi Primer (GC) and left to dry (Fig. 14e). Finally, a thin layer of unfilled resin - Composite Primer (GC) - was applied.

Fig. 14a: Onlay

Fig. 14b: Etching with 9.5% HF

Fig. 14c: Etched surface

Fig. 14d: Cleaning and removal of remnants with H_3PO_4

Fig. 14e: Application of GC Multi Primer

Fig. 14f: Inner surface of pretreated restoration

The use of Composite Primer is not an obligatory step, according to the manufacturer's instruction. The protocol we follow in the clinic includes a thin layer of unfilled resin. Composite Primer contains 2-hydroxyethylmethacrylate, which connects with the methacrylate groups of G-Multi Primer. This way, a thicker inhibited layer of resin is created to which the adhesive resin cement can bond. It was not exposed to light until the resin cement was applied.[15] Tooth №17 was cleaned with 27 µm aluminium oxide powder (under 2MPa air pressure). The enamel was selectively etched with orthophosphoric acid, rinsed thoroughly and dried, after which G-Premio BOND (GC) was applied (Figs. 15-16). After 10 seconds, it was dried using maximum air pressure and polymerised for 10 seconds per surface. G-CEM LinkForce (GC), a dual-cure adhesive luting cement (Fig. 17), was applied on the inside of the onlay. The prepared onlay was seated with slight occlusal pressure (Fig. 18). After tack-curing the cement 2 seconds per surface, the excess could be easily removed with an instrument. The interdental space was cleaned with Super Floss and after the

Fig. 15: Selective acid etching with H_3PO_4

Fig. 16: Application of G-Premio BOND

application of glycerine gel along the margins, it was fully polymerised, curing 60 seconds per surface. At the end, the gel was rinsed off, the margins were checked for residual cement excess, and the approximal surfaces were polished with metal and plastic polishing strips with decreasing grit size. The rubber dam was removed and the margins were finished with Diacomp Twist (EVE) rubber polishing disks at 5000 rpm with minimum

pressure and without water spray. A goat hair brush at 5000-10000 rpm was used without pressure for the last dry polishing step to obtain a high-gloss surface (Fig. 19).
Due to the type of the preparation edge of tooth №47, it was impossible to isolate it with rubber dam. An astringent was applied to dry the sulcus (Fig. 20) and a Teflon retraction cord was placed (Fig. 21). The tooth was cleaned with a brush and prophy paste

Fig. 17: G-CEM LinkForce - dual cure adhesive cement

Fig. 18: Seating of the onlay on tooth n°17

Fig. 19: Cemented onlay

Fig. 20: Use of an adstringent for drying the sulcus

Fig. 21: Placement of Teflon retraction cord

Fig. 22: Verification of the occlusal contacts

Fig. 23: Final result tooth n°47 a. occlusal view; b. vestibular view

(fluorine free), application of G-Premio BOND (GC) for 10 seconds, left undisturbed for 10 seconds. An air spray was used to dry the surface for 10 seconds with maximum air pressure. The adhesive was light-cured for 10 seconds per surface.

After the application of G-CEM LinkForce, the crown was placed on the tooth. The procedure was the same as for tooth №17, except that the excess cement was removed after complete polymerisation of the cement because bleeding occurred during the procedure. For that purpose, a sharp point periodontal curette, Montana Jack (PDT), was used. Finally, the Teflon cord was also removed and the occlusal contacts were checked (Fig. 22). Thanks to the digital design, the occlusal and approximal contacts corresponded to the contacts planned in the design.

Final check-up

After one week, the adaptation of the restoration, the appearance after rehydration of the teeth and the condition of the gingiva were examined during the final check-up (Figs. 23-24).

Fig. 24: Final result tooth n°17 a. occlusal view; b. vestibular view

Case 2 - Indirect restorations in the anterior region

Initial Situation and treatment plan

The patient was referred to us because of endodontic problems. Her chief request was to improve the aesthetics of her front teeth (Figs. 25-28). Since there was a significant amount of calculus, the teeth were first cleaned and polished. Meanwhile, the treatment plan was set up:

Fig. 25: Frontal view of the upper teeth at initial visit

Fig. 26: Side view (right) of the upper teeth at initial visit

Fig. 27: Side view (left) of the upper teeth at initial visit

Fig. 28: Occlusal view of the upper teeth at initial visit

1. Removal of the caries and defect restorations and build-up of the teeth.
2. Endodontic retreatment, including removal of the fiber post from tooth №11 and parapulpal pin from tooth №21 and internal bleaching of №11 and 21.
3. Placement of fibre posts and build-up of teeth №11 and 21.
4. Removal of the old material and parapulpal pin from tooth №22 and build-up
5. Mock-up to specify the aesthetics.
6. Preparation of central incisors for full-ceramic crowns according to the Verti Prep method (BOPT) and temporary crowns.
7. Preparation of lateral incisors, gingivectomy of tooth №12 and temporary veneers.
8. Scanning for permanent restorations.
9. Milling and characterisation of the restorations.
10. Try-in of veneers and crowns and cementation.
11. Final check-up.

Fig. 29: Central incisors after internal bleaching and a first build-up

Preparation

During the first visit, rubber dam was placed and the old restorative material was removed. The parapulpal pin was removed from tooth №21. Teflon was placed to facilitate the work of the endodontist and then the teeth were built-up using a silicone index that was made from the teeth impression before preparation. The adhesive protocol was the same as described in case 1 for the molars. The direct temporary restoration was made using G-ænial (GC; shade A2) and G-ænial Universal Flo (GC; shades AO2 and A2).

Fig. 30: Direct capping of the pulpal communication (a) of tooth n° 22 with MTA and Fuji IX fast glass ionomer cement (b).

Endodontic treatment and internal bleaching

During the second visit after the placement of rubber dam, the fiber post was removed from tooth №11 and then endodontic retreatment of the two central incisors was carried out by an endodontist. Radiographic examination of the teeth confirmed the quality of the root canal filling. To protect the root and the canal obturation, an adhesive barrier was placed in the orifices and a bleaching gel (sodium perborate dissolved in distilled water) was applied in the endodontic cavity.

Core build-up

Fourteen days after removing the bleaching agent from the endodontic cavity, the fibre posts were placed in the teeth - GC Fiber Post 1.0 (GC) in tooth №11 and GC Fiber Post 1.2 (GC) in tooth №21. The used protocol included: sandblasting with 27 µm aluminium oxide particles, rinsing, selective enamel etching for 30 seconds, application of Gradia Core Self-Etch Bonding Liquid (GC) , which was left undisturbed in the root canal for 30 seconds, mild air-blow to remove only the excess bonding liquid and subsequent light-curing for 20 seconds. The posts were luted with Gradia Core (GC) and light-cured for 40 seconds. Then, the build-up of both incisors was completed and final polymerisation was done for 20 seconds from each side (Fig. 29).[11]

Digital mock-up and temporisation

During the fourth visit, the old restoration and the parapulpal pin were removed from tooth №22. Vitality of the tooth was tested before the administration of the anaesthesia and appeared normal. The removal of the parapulpal pin resulted in communication to the pulp cavity of the tooth (Fig. 30a).

Fig. 31: Temporary restorations on the central incisors. The restorations were made chair-side with an auto-curing acrylic material.

The bleeding was controlled within one minute and the blood had a normal colour. Given the specific situation, we decided to apply MTA (Neo-MTA Plus, Avalon Biomed) and to build up the tooth. After application of the MTA, a glass ionomer cement (Fuji IX fast, GC) was applied over it in a very thin layer (Fig. 30b). Next, we followed a standard adhesive and restoration protocol. We scanned the teeth and made a digital wax-up and mock-up. We took an impression from the mock-up to transfer the desired shape to the teeth of the patient.
The patient approved the new shape and position of the teeth. [12]

The central incisors were prepared for full-ceramic crowns with minimal preparation in accordance with the Verti Prep method using the mock-up as a reference. [3] Temporary crowns were shaped using the preliminary taken impression. The temporary crowns were gingivally contoured to form an adequate zenith for the future porcelain crowns. The crowns were left for 4 weeks to shape the gingiva (Fig. 32).

Fig. 32: Central incisors after preparation and temporisation: a. frontal view; b. occlusal view. The gingiva was in a good condition, hence it was possible to proceed with the scanning procedure

Fig. 33: Checking the finished preparations. There is sufficient space for the future crowns and veneers.

Final preparation & scanning

After the temporization period, the condition of the gingiva of the central incisors was checked during a follow-up appointment (Fig. 32). This allowed us to proceed to the preparation of the laterals and the final scanning for permanent restorations. Using the mock-up transferred to the patient's teeth as a reference, a gingivectomy was done on tooth №12 and both laterals were prepared for vestibular veneers (Figs. 33). The preparation was within the limits of 0.3-0.5 mm reduction. After the primary preparation, retracting cords were placed in order to position the edge of the veneers at 0.2-0.5 mm below the gingival margin. After preparation, finishing and polishing of the teeth, we proceeded to the scanning with Cerec Omnicam (Sirona) (Figs. 34-35). Two retracting cords were placed in the sulcus of each tooth and the thickest cord (coronary position) was removed immediately before scanning. After the scanning, the temporary crowns of the central incisors were cemented. Temporary veneers were made on the laterals using an impression of the wax-up and cemented using the spot-etch method. [13, 14]

Milling & characterization

The crowns and veneers were milled from Initial LRF Blocks, A2 HT C14. Then, they were characterised with oxide paints and glazed with Initial LRF Glaze Paste.

Cementation

During the next visit, the shade of the cement was chosen using G-CEM LinkForce try-in paste (GC). Shade A2 was selected. The patient approved the shape and colour of the porcelain restorations. They were then prepared for cementing using protocol of first case.

After isolation with rubber dam, the teeth were sand-blasted with 27 µm aluminium oxide at 2 MPa pressure. The enamel was selectively etched with orthophosphoric acid and after rinsing and drying, G-Premio BOND was applied. After 10 seconds, the excess was blown with maximum air pressure and the adhesive was light cured for 10 seconds per surface. The central incisors were cemented first to avoid distortion of the central line by using the dual-cure adhesive luting cement G-CEM LinkForce. The restorations were placed simultaneously onto the teeth with slight pressure. After tack-curing for 2 seconds per surface to gel the cement, the excess was removed. The interdental space was cleaned with dental floss and after applying glycerine gel along the margins, the cement was light-cured for 60 seconds per surface. Next, the veneers were cemented using the same adhesive protocol (Figs. 36-37). After polymerization, the approximal surfaces were polished with metal and plastic polishing strips, and the margins were polished with rubbers and brushes with minimum pressure. The approximal and occlusal contacts were checked after removal of the rubber dam; a minimal articulation adjustment was necessary.

Fig. 34: Determination of the margin lines of the future crowns and veneers in the software.

Fig. 35: Permanent restoration design.

Fig. 36: Tooth n°22 after isolation and etching and before cementation

Fig. 37: Tooth n°22 after cementation with G-CEM LinkForce

Fig. 38: Frontal view of the upper teeth, one week after treatment.

Fig. 39: Side view (right) of the upper teeth, one week after treatment.

Fig. 40: Side view (left) of the upper teeth, one week after treatment.

Final Check-up

The final check-up was scheduled after 7-10 days to check the adaptation of the restorations, appearance after the rehydratation of the teeth and the condition of the gingiva (Fig. 38-39-40).

Conclusion

The use of leucite reinforced glass-ceramics for the restoration of anterior and posterior teeth is a good and easy option for achieving aesthetic and functional restorations. Its combination with digital technologies (CAD/CAM) gives the dentist the opportunity to attain a preliminary expected positive result.

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Thinking outside the box is in demand

Hybrid ceramic material as a supplementary material for CAD/CAM for single tooth and implant treatment.

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In 2013 his article was awarded best lecture by the Arbeitsgemeinschaft Dentale Technologien (Dental Technologies Consortium) ADT.
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Alongside the proven silicate and oxide ceramics, a new group of materials has been coming into focus for CAD/CAM manufacturing. Hybrid ceramics, as they are called – a combination of composite and ceramic. This article introduces the hybrid ceramic CERASMART™ (GC). The author describes why this material makes him think outside the box, which indications it can solve, and what the advantages are.

Thinking outside the box is in demand

"If you have the choice between oysters and champagne, you tend to choose both." (Theodor Fontane) This poetic quote introduces an article on CAD/CAM materials. Here, we must choose daily between different high-quality materials and have to make decisions based on indications. A new group of materials – hybrid ceramics – has been available for CAD/CAM manufacturing for some time now, and unites the positive characteristics of ceramic with those of a modern composite. While ceramic was seen as the gold standard of tooth-coloured restorations for a long time, this mixed ceramic is a worthwhile alternative for certain indications. But what characterises a hybrid ceramic, and when is it sensible to use one? This article aims to provide answers to these questions, both in terms of the material and from a user's perspective, using Cerasmart (GC) as an example.

1. Hybrid solutions

"Hybrid" means a mix of things from two sources. The goal is to unite the best of two worlds, for example in order to open up new areas of application.

Examples of hybrid solutions:	
Hybrid computer:	PC and tablet
Hybrid car:	Electric motor and combustion engine
Hybrid telephone line:	Landline and mobile
Hybrid app:	Android, iOS and other mobile platforms
Hybrid ceramic:	Plastic and ceramic

We are confronted with hybrid solutions in day-to-day life. Proven solutions are cleverly combined in dental medicine as well. New indication fields and material groups often result, for example hybrid ceramics. But what exactly defines a hybrid ceramic, and what is its use? In order to answer this question, a material/technical overview of the proven ceramic restoration materials is required.

2. Ceramic restoration materials

Ceramic is a biocompatible material with a wide range of applications. Excellent results are possible assuming an accurate indication and professional usage. But we have to accept all of the failures that have occurred over the years. Material and technical limits have been exceeded many times, and experiments have been risked that did no favours to the reputation of full ceramic. Discussions concerning stability, antagonist protection and chipping still trigger scepticism to this day. Research was carried out. Ceramic treatment protocols were established. Technologies and materials were improved. But after all these years of euphoria, it remains clear that ceramic as a framework and restoration material has limits that we must accept.

On the other hand is the desire for tooth-coloured materials, which have convincing aesthetic properties similar to those of glass ceramics. A further demand is the practical usability and lower risk of failure. Zirconium oxide in particular is usage-sensitive, presents significant challenges and hides potential errors in practical use. Nevertheless, the strength and wear process of zirconium oxide give it clear validity. For small restorations, the high-strength glass ceramic lithium disilicate has won through in many cases. The ability to transmit light is detrimental to aesthetic requirements. All in all, we can say that ceramic restorations have good long-term prognoses provided indications and handling follow exact rules.

3. Thinking about new possibilities

With conscious redundance, ceramics require adhering to a systematic treatment process and following clearly defined fields of indication. Ceramic restoration materials are state-of-the-art and have a strict field of indication. We currently do not have a "universal ceramic". There are many areas of application in which rethinking traditional concepts of ceramics is a good idea, and new materials can be taken into consideration. Examples of this are:

- Monolithic manufacturing: The optimal material should roughly correspond to the biomechanical properties of a natural, intact tooth. If we compare the elasticity module of natural dentine with conventional ceramics for monolithic treatment, it is clear that we hardly live up to the example of a "natural tooth".
- Implant prosthetics: A lot of research

has been carried out in recent years into implant constructions. We too have been actively following many studies. But what happens to the superstructure in the lateral tooth area, which undergoes the pressure of chewing? Veneered crowns are subjected to a very high risk of chipping. The reason: implants cannot move on their own and have significantly reduced tactility. A material with slightly ductile properties is therefore desirable for implanted crowns, ideally one that also shows low plaque accumulation.

- Bruxism: Here the balance between sufficient stability and tooth-like abrasion has to be mastered. A material with a certain elasticity would be ideal. This allows high chewing forces to be partially compensated for.
- Temporary treatments and splints: The patient's aesthetic wishes should be fulfilled here as well. Efficiency is also required. Tooth-coloured materials with photo-optical characteristics similar to glass ceramics are therefore optimal. They can also be manufactured efficiently using CAD/CAM.

4. Hybrid ceramic: definitely (not) a ceramic

In everyday working life there are borderline situations where conventional ceramics can't help us. Alternatives are required. In the search for CAD/CAM materials with optimal physical and aesthetic properties, hybrid ceramics are seeing growing interest. We have been frequently using a mixed ceramic material in recent months when giving single-tooth treatments: the hybrid ceramic Cerasmart. Offered as a ceramic block, this material excellently supplements our product portfolio of CAD/CAM materials.

Material science

Like every hybrid ceramic, Cerasmart unites the advantages of ceramic and composite. The ceramic aspect ensures tooth-like photo-optical characteristics, while the polymer component gives the material biomechanical characteristics similar to those of a natural tooth. In a special composite technology (glass filler technology), a variety of silicate fillers and tiny particles are added to the polymer matrix. (Barium borosilicate glass filler 300 nm, silicone dioxide particles 20 nm.) The shock-absorbing properties declared by the manufacturer are particularly notable here. The slight "flexibility" likely provides a slight buffering of chewing forces. This makes the material interesting for implant prosthetics, among other things. The low plaque accumulation is also an argument for implant-based prosthetic restorations. For processing, the following applies: the restorations are carved out of blocks using the wet grinding process. The hybrid ceramic can only be processed in dry grinding mode in CAM.

Bending strength = 231 MPa
E-module = 7.4 GPa
Compressive strength = 643 MPa
Vickers hardness = 73 GPa

Application

Cerasmart is suitable for CAD/CAM manufacturing of metal-free, indirect single-tooth restorations such as crowns, in/onlays and implanted crowns. Application is uncomplicated and efficient in design. Restorations are milled as usual in CAD constructions (Figs. 1 to 3). Short milling times and

1


2


3


Figs. 1 to 3: Work steps up to the finished Cerasmart restoration: scanning (here Aadva laboratory scanner), construction, wet grinding (here in the N4 milling machine).

form-fitting results go hand in hand. The steps up to the finished product stand out significantly from known materials. The crown does not need glazing in an oven. Depending on the indication, simple manual polishing or custom characterisation using light-hardening sealing and colouring technology GC Optiglaze Color is carried out.

Configuration

The Cerasmart blocks are offered in three sizes. From a large 14L (large) block, long teeth (canines, implant crowns) can be carved.
Block size 12 (L/B/H) = 15 / 12 / 10
Block size 14 (L/B/H) = 18 / 14 / 12
Block size 14L (L/B/H) = 18 / 14 / 14

The hybrid ceramic blocks are offered in different colour tones and with different levels of translucency. A distinction is made between LT (low translucency) and HT (high translucency). Thanks to the selection of different basic colours (A1, A2, A3, A3, A5, B1, bleach), every colour-related challenge can be overcome.

Aesthetics

Due to the ceramic filler materials, photo-optical characteristics are offered that are similar to glass ceramics. A relatively harmonious balance between fluorescence and opalescence is achieved. If an aesthetic character is desired, we use Optiglaze Color (GC), a light-hardening surface sealant available in various colour applications. The colour is applied with a brush and hardened. Due to the nano-filler technology of Optiglaze, high abrasive stability, long-lasting gloss and colour-fastness are guaranteed.

5. Indications and application examples

The new material class is based on a mix of nano-ceramic particles that are embedded into the highly-interlaced polymer matrix using a patented manufacturing process. The result is a restoration with a brilliant, permanent gloss. Cerasmart is approved for definite indications. We also use it for temporary solutions. The material is comparably elastic. The low brittleness and absorption capabilities allow indications where conventional ceramics would reach their limits. This includes, for example, single-tooth treatments for bruxism patients or on endodontic pre-treated teeth, implant crowns (crown abutments) or onlay splints. Due to the simple milling process and the fact that firing is not required, an efficient work process is guaranteed. Construction, wet milling, done! The dental laboratory can therefore count on high productivity. Customisations are available where required. The level of gloss similar to that of a natural tooth is realised by polishing or using a sealing/colouring material.

5.1 Single crowns (Figs. 4 to 14)

The tooth-coloured treatment of individual teeth is a classic indication for full ceramics. Until now we have always fallen back on ceramic veneers or monolithic manufacturing from lithium disilicate or zirconium oxide: sometimes with a high level of uncertainty. This includes, for example, bruxism patients or endodontically pre-treated teeth. In these cases it is important to redirect high chewing forces away from the tooth, or at least to dampen them. A material with similar biomechanical characteristics as a natural tooth is ideal, such as Cerasmart. But in the front tooth region as well, aesthetically successful hybrid ceramics can be achieved, for instance for temporary treatments.

Work process

1. Construction

We work with the Henry Schein ConnectDental system, which was conceived for open solutions, and combines the generated data directly with CAD software/the manufacturing unit. This allows data on intraoral impression taking – especially relevant for individual crowns – to be processed without issues. If a conventional impression is taken, the model is digitised. We use the laboratory scanner Aadva Lab Scan (GC), which is also integrated into ConnectDental. GC Aadva Lab Scanner features a dual camera system with integrated LED lighting. This projection and measuring technology allows high accuracy and fast scanning.

2. Grinding

Cerasmart is offered as a universal block for all common milling machines. For temporary individual crowns, a lightly translucent block is chosen (Cerasmart LT). The construction is made using the N4 milling machine integrated with ConnectDental (vhf camfacture AG, Vertrieb Henry Schein). We have learned to love this small, fast machine due to its compact construction and high precision. The block is carved in wet grinding mode. A membrane pump fitted into the milling machine, as well as a system for preparing air and liquids, ensure that the exhaust air is dried and the

Fig. 4: Starting position. The four front upper teeth are to be treated.

Fig. 5: Wax model.

Fig. 6: The wax model was transferred to the hybrid ceramic Cerasmart.

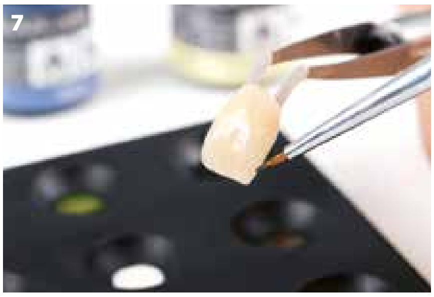


Fig. 7: The custom surface characterisation is carried out with Optiglaze Color.

Figs. 8 & 9: The finished temporary crowns (only painted) on the model as well as in the mouth. Both the surfaces and the brightness seem completely natural, alive and aesthetic.

Fig. 10: Reduced crown frameworks in the vestibular area (zirconium oxide) for definite treatment.

Fig. 11: The custom veneered ceramic crowns (GC Initial).

cooling fluid cleaned of grinding particles. Within a short amount of time, the crown is carved and prepared for completion.

3. Finished

The fit is excellent. Subsequent work is hardly necessary. Since it is a temporary tooth, we want to get to the finished result quickly: without having to make compromises in terms of aesthetics. We decide on custom characterisation of the crown with nano-filled sealing and painting colours (GC Optiglaze Color, GC). After working in a light micro-texture, the crowns are given coloured accents with materials ready for use. Ceramic Primer II (GC) is recommended for chemical bonding with hard hybrid materials. A very thin layer of Optiglaze is applied (thickness 20-25 µm) and light-hardened. We choose the desired colour from a palette and apply it with a fine brush. Slightly blue in the area around the incisal edge, slightly warm red in the fissures and at the cervical edge – a thin layer gives a life-like colour depth, translucency and a natural gloss. Polishing is not required. Alongside colouring, Optiglaze also offers another valuable advantage. The surface is sealed and the danger of plaque thereby significantly reduced. According to the manufacturer's specifications, the colour remains stable long-term (lasts up to 50,000 cleaning cycles, equating to around five years).

Figs. 12 to 14: Beautiful integration of fully ceramic treatment. Optimal conditions for the soft tissue could be achieved during the provisional phase with Cerasmart.

5.2 The onlay as a treatment "splint"

(Figs. 15 to 18)

Even when treating heavily worn and eroded teeth, the goal is to absorb high chewing forces and protect the teeth. Hybrid ceramics offer excellent alternatives in this situation, for example to traditional splint technology. Especially when reconstructing chewing surfaces, the material shows excellent clinical characteristics. These are essentially based on the successful combination of the starting material and the filler technology described previously.

Figs. 16a & b: The onlays are virtually modelled following digitisation of the situation using construction software.

Cerasmart is highly resistant to bending and to pressure. Paired with an E-module, and therefore with lower brittleness, permanent elastic properties result. The hybrid ceramic therefore offers the ideal requirements for rehabilitating a patient with worn or eroded teeth in the form of a tooth-coloured onlay splint.

Figs. 17: The carved and processed onlays (Cerasmart) on the model.

Fig. 15: Highly eroded teeth in the lower molar region. Onlays are to be made to protect the teeth."

Fig. 18: Intraoral situation with onlays already fixed in place.

Work process:

1. Construction

Here, too, ConnectDental is the path to success. Various processing technologies can be combined in the open complete solution phase.

2. Grinding

In this case we choose a translucent block (HT) in a light colour suitable for replacing enamel. The onlay is then recarved in the N4 vhf milling machine. Cerasmart can be milled very thinly (down to 0.3mm) and has a high edge stability, which is especially important for onlays.

3. Finished

The onlays are completed as described previously. Thin trays are the result, showing a natural colour depth as a replacement for chewing surfaces. Before they are put in place, enamel and dentine are corroded using a phosphoric acid gel, dentine primer is applied and the adhesive rubbed in. The restoration is pre-treated with hydrofluoric acid (5%) and conditioned with Ceramic Primer II. Composite cement is used to fix it on to the tooth. The patient will be satisfied with this type of "onlay splint" for a long time.

Fig. 19: The crown abutment is highly regarded at the moment. Cerasmart is ideal for this purpose. Without having to mount the carved crown by hand, it sits perfectly on the titanium base.

Unlike a typical bite block splint, it is invisible in the mouth. The natural teeth are preserved and the jaw is not burdened unnecessarily. It should be expected for onlay splints to show abrasion properties similar to enamel in the long term. Attrition of the Cerasmart chewing surface is similar to that of a traditional hard tooth substance.

5.3 Implant crowns/hybrid crowns

(Figs. 19 to 31)

As a material for implant crowns, for some indications we often choose Cerasmart, and therefore choose to combine the aesthetic advantages of a silicate ceramic with the elastic properties of plastic. The ductility associated with the elasticity module is a positive for implant-based prosthetic treatment, since it guarantees physiological force transmission on to the implant. The comparatively elastic material compensates for the high chewing forces acting on an implant anchored firmly into the bone. This buffering/absorption seems to have a positive effect on the peri-implant tissue. Cerasmart also has excellent surface properties. The low plaque accumulation complements the long-lasting gloss.

We usually manufacture a hybrid abutment, treated with a superstructure, using zirconium oxide. In marginal areas in particular, this high-strength material ensures the necessary security. In the posterior region, Cerasmart is highly suited to the hybrid crown (crown abutment), an indication that is becoming more and more popular. The crown is milled from a block, significantly reducing the chance of a fracture.

For every implant

Unlike other CAD/CAM blocks for implant crowns, Cerasmart does not have any pre-assembled connecting geometry, but is instead glued on a titanium basis – as is the case for other abutments (Fig. 16). Users are therefore not reliant on closed systems with defined connecting geometry of fewer implant systems. We have the freedom to create a precise-fitting hybrid crown for every implant. We have quickly learned to appreciate this special feature.

Work process:

1. Construction

Following the digitisation of the situation (intraoral or via the model), fully anatomical individual crowns are constructed and later fixed on to the titanium base.

2. Grinding

The fully anatomical crowns are carved in the N4 vhf milling machine.

3. Finished

Preparation occurs simply and quickly. The crown is united with the titanium base using a systematic gluing process. In order to give the crowns additional character with colour, we also work with nano-filled sealing and colour material. Similar to working with ceramics, a beautiful flowing colour can be achieved. This method is our answer to the often-discussed aesthetic limitations of hybrid ceramics. The implant crowns from hybrid ceramics are aesthetic, and offer dampening properties, which are particularly important during the osseointegration phase.

Fig. 19: The materials for the gluing process – hybrid crowns on a titanium base.

Fig. 20: Before gluing, a mark is made on the titanium base and the crown is drawn on to it for optimal reference.

Fig. 21: The gluing surface is wetted evenly with primer.

Fig. 22: The fixing material is only applied to the upper third of the gluing base.

Fig. 23: The crown and titanium base are joined.

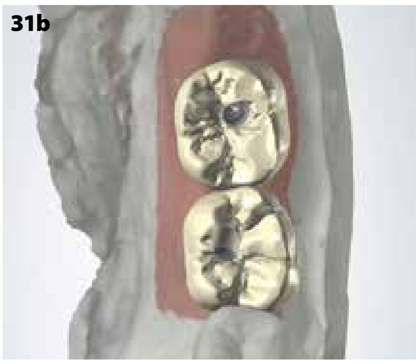
Fig. 24: Oxygen-repelling glycerine gel is applied to the glue joint.

Fig. 25: Optiglaze Color (GC), a light-hardening nano-filled sealing and colour material serves as a way to add character to crowns.

Figs. 26: Applying Ceramic Primer II.

Figs. 27 & 28: The surfaces have character added to them in the form of colour quickly and easily using a brush. Similar to working with ceramics, a beautiful flowing colour can be achieved. In the occlusal area, it is recommended to apply the colour in a targeted fashion using a fine needle.

Figs. 29 & 30: Light hardening is first carried out using a hand-held light and then with a light-curing device. The intensity of the light hardening is a decisive factor for the final result.



Figs. 31a to c: The path to hybrid crowns – digital model, construction, finished crowns.

6. The bond

To fix the hybrid ceramic restoration, we refer to current scientific standards. In a study by Stawarzyk et. al., they advise using a bonder every time [1]. The following materials were suggested:

1. Composite and zirconium oxide: Scotchbond Universal (3M Espe) for pre-treatment and RelyX Ultimate (3M Espe) for bonding.
2. The composite is pre-treated with visio.link (bredent) and the zirconium oxide with Monobond Plus (Ivoclar Vivadent). Bonding is carried out with Variolink Esthetic (Ivoclar Vivadent) and Multilink Implant (Ivoclar Vivadent).

The manufacturer of Cerasmart (GC) recommends using an adhesive plastic element for the bond. In April of this year, the material G-Cem Linkforce was introduced to the market. A primer (Ceramic Primer II) should also always be used. This ensures the bond to all plastics/bonding materials is secure.

7. Conclusion

Ceramic is a durable, stable material that allows excellent aesthetic results. We love ceramic, but we are aware of the failure rates. These can be attributed firstly to application sensitivity, and secondly to material properties. Depending on the indication in question, considering new materials is definitely worthwhile. We are ready for new techniques, and we have a responsibility to reduce failure rates as much as possible.

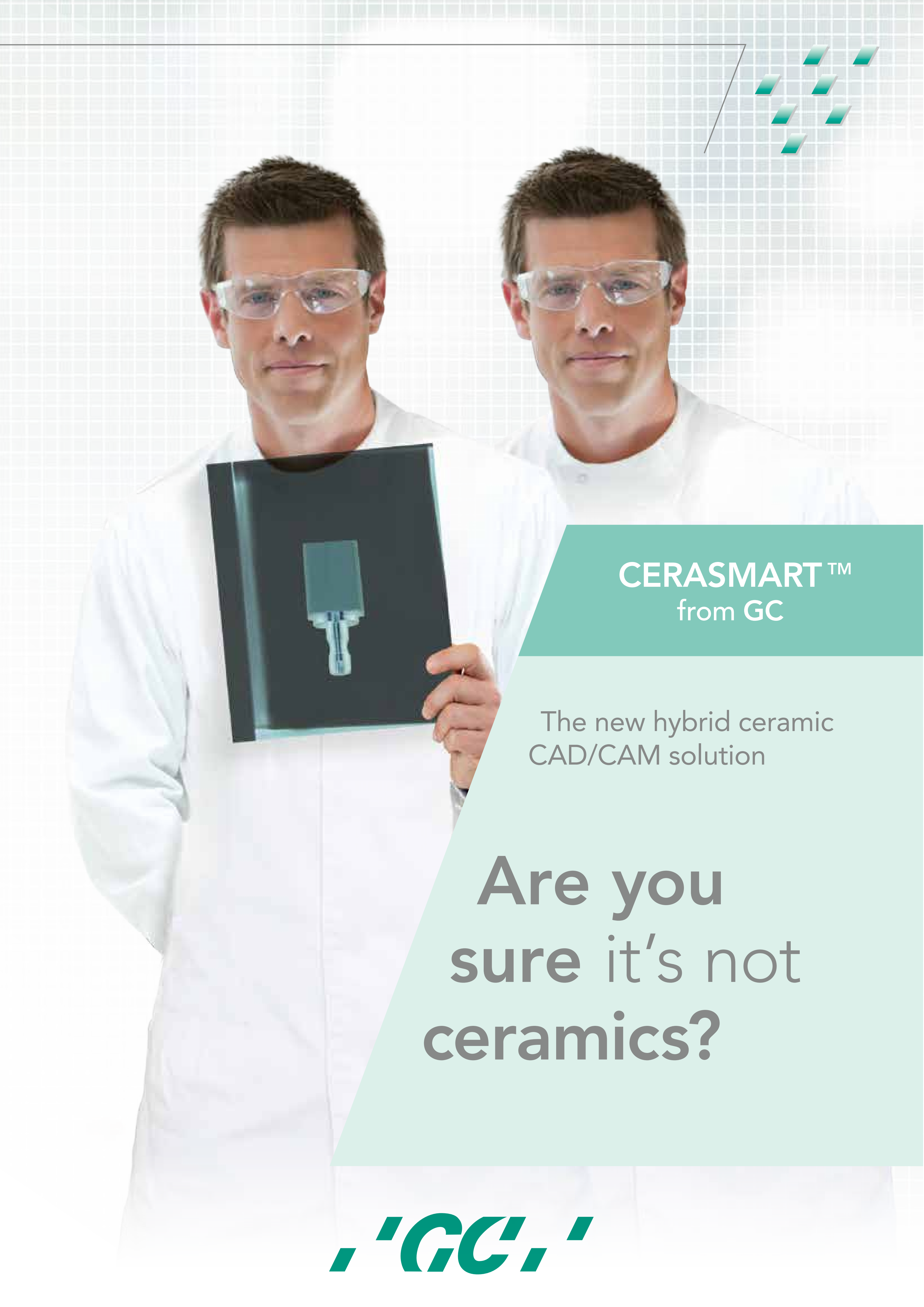
Hybrid means combining elements that have each proven themselves on their own: for example ceramic, with highly aesthetic, biocompatible properties, and composites, which have glass-ceramic fillers and permanently elastic properties. By combining both materials, hybrid ceramic (as well as bonding and mixed ceramic) result. The hybrid ceramic Cerasmart allows restorations to be made where using a traditional ceramic would be questionable. Furthermore, new application areas are opened up, for example onlay splints. Advantages include the slight flexibility of the material (ductility), the high edge stability (minimum wall strength 0.3mm), simple usability (no firing required), and the high surface thickness (long-lasting gloss). It offers possibilities for ensuring high security while at the same time guaranteeing efficient use and adequate aesthetics.

Literature

[1] Stawarczyk B, Liebermann A, Eichberger M, Güth JF, Evaluation of mechanical and optical behavior of current esthetic dental restorative CAD/CAM composites, Journal of the Mechanical Behavior of Biomedical Materials 55 (2015) 1–11

Product List

Scanner	Aadva Lab Scan	GC
Grinding machine	N4 milling machine	vhf camfacture (Vertrieb Henry Schein AG)
Hybrid ceramic	CERASMART™	GC
Primer	Panavia V5	Kuraray Noritake
Adhesive bonding material	G-CEM LinkForce	GC
Sealing and colour material	Optiglaze Color	GC
Light curing unit	Highlight Power	Heraeus Kulzer



CERASMART™
from GC
The new hybrid ceramic
CAD/CAM solution
Are you
sure it's not
ceramics?

User report

Enhance your diagnostics

What can we understand from light-induced fluorescence?

By **Dr. Stephane Browet,** Belgium

Dr. Stephane Browet

Stephane Browet graduated in 1995 as a dentist at the Vrije Universiteit Brussel (VUB) and completed a two-year postgraduate degree in Aesthetic Dentistry at the same university. Currently, he works in group practices in Ternat and the south of Brussels (Alsemberg).

Stephane is a nationally and internationally renowned speaker and course leader. Subjects include placement of rubber dam, composite techniques, microscope enhanced dentistry, prosthetic dentistry and practice management. He is a member of the European Society of Microscope Dentistry (ESMD) and of the Bio-Emulation Colloquium.

A curing light is a necessity in every dental practice. The GC D-Light® Pro is a dual wavelength LED light-curing device which can cure all modern composites efficiently, regardless of the photo-initiators they contain. But it does more: in the detection mode, the optical property of fluorescence can provide a lot of information that can be useful for your diagnostics and help you in areas that you might even not have thought of before.

Enhance your diagnostics What can we understand from light-induced fluorescence?

GC D-Light Pro is a small and lightweight curing device that contains two LED lights with different peak wavelengths: one emits blue light at 460-465 nm and the other one "near-UV" violet light at 400-405 nm. This results in a **wide spectrum and the ability to cure all materials, regardless of the photo-initiator used in their formulation**. In the detection mode, D-Light Pro only emits violet light at a low intensity (390 mW/cm^2).

Fluorescence is a form of luminescence, where the substance absorbs light and spontaneously re-emits lower-energy light of a longer wavelength. Human teeth emit autofluorescence, which is stronger in dentin than in enamel[1]. In general, the fluorescence of a substance is very sensitive to small differences in structure or composition. Thus, **a thorough investigation of the fluorescence of enamel and dentin can reveal details of structure not made apparent by other methods**. For example, incipient caries and white spot lesions exhibit a decreased native fluorescence[2]. On the other hand, **bacterial metabolites called porphyrins within the dental biofilm exhibit a typical orange/red fluorescence, which is associated with active caries lesions**[3]. The fluorescence-aided caries excavation (FACE) technique is based on this phenomenon of auto-fluorescence under violet light. Several studies have shown that it is an effective diagnostic tool supporting the minimally invasive concept, by enabling to remove the infected dentin without unnecessary increase of the cavity size[4].

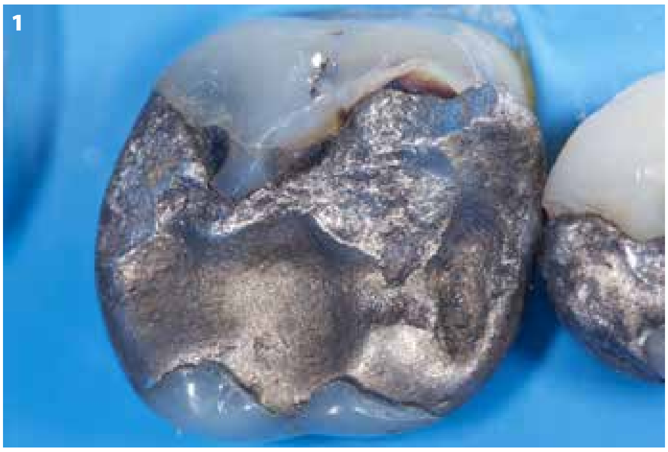


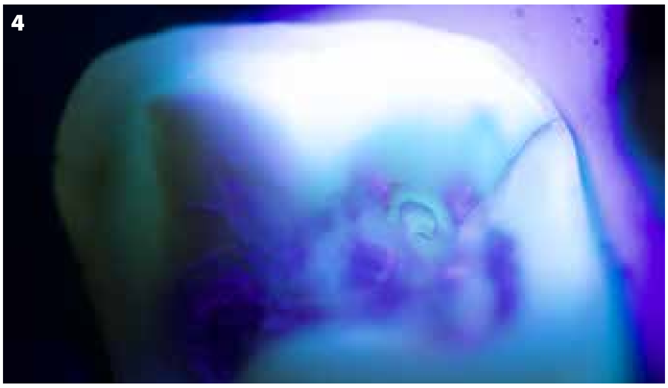
Fig. 1: Molar with an old defective amalgam restoration.

End-point of preparation

The next two cases illustrate how the detection mode is useful in your daily practice. A patient presented with an old, defective amalgam restoration (Fig. 1). After removal of the amalgam, corrosion products and a crack extending into the dentin was detected in the mesiolingual area; the surrounding dentin had a slightly darker appearance (Fig. 2-3). Under the near-UV light of the detection mode, it appeared as a very thin violet line, due to the diffraction of the light at the crack; however, **the dentin surrounding it appeared to be sound and without bacterial metabolites as red/orange fluorescence was not observed** (Fig. 4-5). The cusps were reduced to minimise the risk of crack propagation, but further preparation was not necessary.

Fig. 2: After removal of the amalgam, a crack can be seen at the mesiolingual side of the tooth. The tooth is heavily stained by corrosion products.

Fig. 3: Same tooth, cleaned with air abrasion.



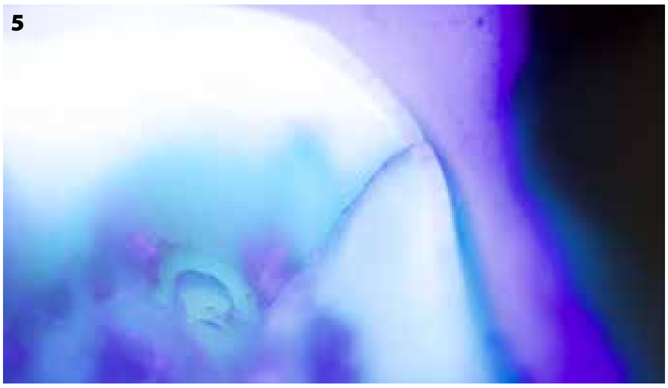


Fig. 4-5: A very thin crack can be seen with a slightly dark appearance; no bacterial activity is apparent.

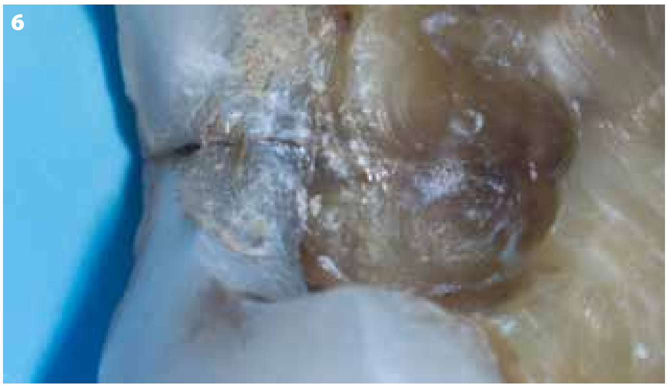


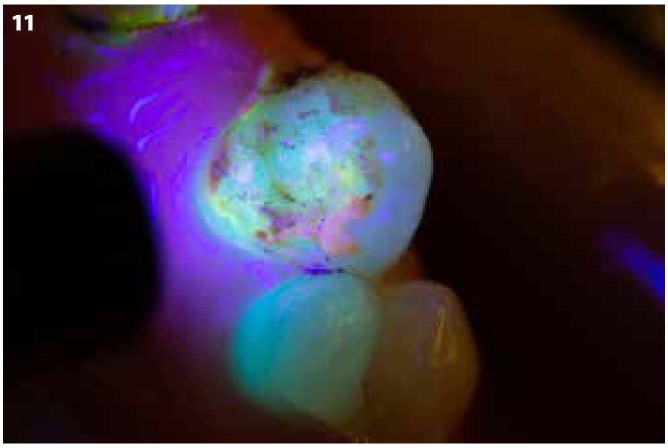
Fig. 6-7: Crack in the proximal box that became more apparent after removing the smear layer.

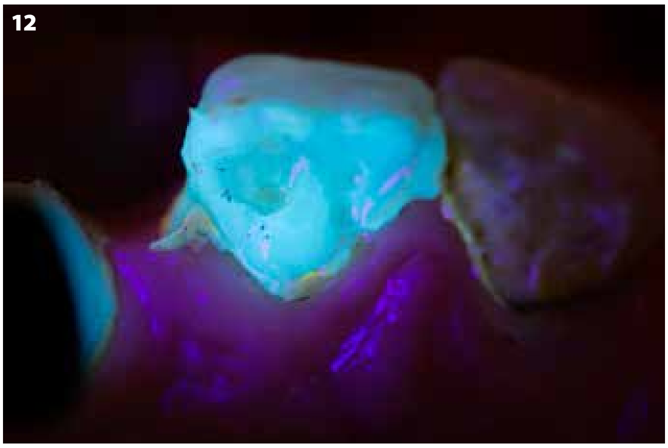
Another tooth had a deep crack, at the proximal margin (Fig. 6). After cleaning (Fig. 7), the structure was better visualised using D-Light Pro in detection mode. The structure of the dental tissues became more apparent, with the dentin exhibiting more fluorescence in a distinct green colour. Now, **it could be clearly seen that the crack was extending into deeper layers of the enamel and further into the dentin** (Fig. 8). The crack was further cleaned and prepared with AquaCare Twin (Velopex) with fine aluminum oxide cutting powder under air pressure and water cooling (Fig. 9). **With the detection mode, it can be confirmed at a glance that the preparation margins are all located in sound enamel** (Fig. 10). The thin hairline crack that can be seen, is superficial and limited to the enamel.

Fig. 8: Fluorescence is sensitive to structural changes. The deep violet colour indicates the deeper part of the crack. The dentin can be clearly delineated due to the faint green fluorescence.

Fig. 9: After preparation, a smooth and sound margin is left.

Fig. 10: With D-Light Pro in detection mode, it is confirmed that the margins are all located in sound enamel. Just a small hairline crack, limited to the enamel, is left.





Figs. 11-12: Detached adhesive bridge. The red fluorescence emitted by porphyrins, metabolic products from oral bacteria, demonstrate the presence of a mature biofilm.

Bacterial metabolic activity

A red fluorescence of biofilm is typically attributed to a mature biofilm, and originates from porphyrins, indicating metabolic activity[5]. Figures 11 and 12 show a detached adhesive bridge. In Figure 13, the biofilm adjacent to the gingival margin can be seen. **An orange-pink fluorescence can be observed, mainly at the rougher surfaces, clearly indicating the sites of plaque retention**. These sites are linked to caries risk and periodontal inflammation, and can be detected at a glance thanks to this feature.

Fig. 13: Red fluorescence from biofilm close to the gingival margin, indicating risk of periodontal inflammation.

Perfect margin control

The majority of resin composites are hyper-fluorescent under near-UV light[6,7]. The otherwise inconspicuous restorations can be easily visualised in the detection mode (Fig. 14). This way, **the presence of overhang can be checked, marginal gaps are more easily defined** (Fig. 15), **and the removal of defect restorations becomes much easier and without unnecessary removal of sound tooth tissue**. Moreover, it becomes a useful aid during luting procedures; resin cement excesses are immediately detected and can be removed (Fig. 16) without simultaneous polymerisation; after cleaning, the same device can be used to cure the margins (Fig. 17). During follow-up, restorations are better visualised (Figs. 18-19) and margins can be inspected quickly and thoroughly.

Fig. 14: Restoration exhibiting hyper-fluorescence in the near-UV spectrum. This feature aids in margin control and removal of old, defect restorations following the minimally invasive concept.

Fig: 15: Close-up of a restoration margin. A subtle gap is visible as a violet line adjacent to the bluish fluorescent restoration.

Fig. 16: Seating of a lithium disilicate onlay; the composite resin (G-ænial Anterior, shade A2) excess that needs to be removed is easily visualised.

Fig. 17: Same onlay as in Fig. 16, after polymerisation. Only a very thin cementation line is visible; the absence of overhang is assured.

Fig. 18: Follow-up of a lithium disilicate onlay, three years after placement.

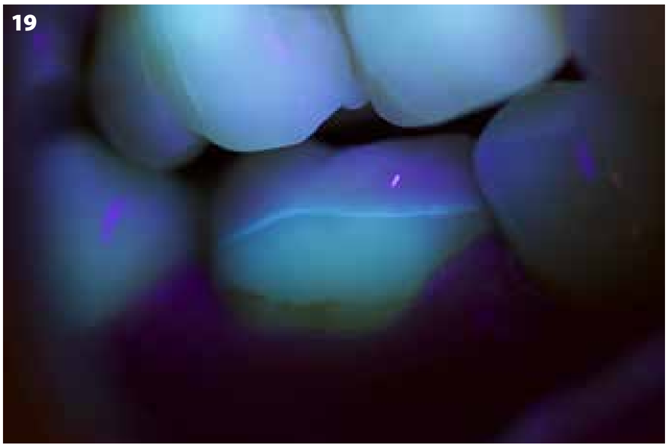


Fig. 19: Same tooth as in Fig. 18. The thin cementation line (G-ænial Anterior, shade A2) is visualised with D-Light Pro in the detection mode. The margins show good adaptation and are caries-free.

The diagnostic mode of the D-Light Pro is an excellent adjunct to clinical decision-making to see beyond what is visible with the naked eye. **The structure of the tooth, bacterial activity and restorative materials can be observed and distinguished at a glance. This way, D-Light Pro also helps to follow a minimally invasive approach whenever this is feasible.** The more you use it, the more it becomes an indispensable tool for your practice!

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Glass ionomers: the material of choice in paediatric dentistry?

The range of indications for glass ionomers in paediatric dentistry is extremely varied (early childhood caries, deep carious lesions on mature and immature teeth, etc.). Review of these materials that have undergone significant technical advances.

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Although in France, glass ionomer cements (GIC) are mainly used by dentists to lute prosthetic pieces, it must be noted that they are less commonly used as a restorative material. In 2012, 56% of restorations were made from composites in comparison with 17% from glass ionomers [1]. According to the report by the French National Agency for Medical Product Safety (Agence Nationale de Sécurité du Médicament et des produits de santé, ANSM) of April 2015, 100% of dentists in France were using composites in 2012, compared with 40% using glass ionomers, which represent 15-25% of direct restorations [2]. These glass ionomers (GI) still suffer from a poor reputation. This reputation stems from the first glass ionomers developed in the 1970s by Wilson and Kent, as a result of their low resistance to flexion and abrasion. These were low viscosity GIs. Slow maturation and stabilization of moisture exchanges were required to achieve properties close to those of composites after one year. They have since undergone significant improvements and are now an excellent alternative to amalgam. Amalgam should now only be used as an exception, in particular for use in deciduous dentition (last resort use) [3]. GIs can also be a substitute for composites which, on a biological level, can pose a certain number of risks. Therefore, although usage restrictions may exist in some clinical situations, their indications are numerous when treating early childhood caries, deep carious lesions in mature and immature teeth, mineralisation defects, interceptive treatment and so on.

Composition and classification

GIs are composed of a mix of organic acids (polyacrylic acid, tartaric acid and itaconic acid) and fluoroaluminosilicate glass particles. The use of the first low-viscosity GIs was quickly abandoned due to their weak mechanical properties and great sensitivity to the moist conditions of the mouth. New GIs then started to appear on the market. Some GIs have been modified with the addition of resin (RMGI), others are condensable after modification of the liquid/powder ratio and the particle size (high-viscosity GI - HVGI). The addition of freeze-dried polyacrylic acid to the powder makes it less sensitive to osmosis [1]. One last family (sometimes classified in the HVGI family) is strengthened with very small fillers (< 4 µm), which accelerate the setting of the matrix (high-density glass ionomers - HDGI) (table 1). For both HVGIs and HDGIs, a coating is used to markedly increase the long-term mechanical properties (impregnated protected GI). This treatment comprises a nanofilled self-adhesive resin that combines extreme hydrophilic properties with very low viscosity. It compensates for the microporosity of GI [4] which is thus protected from desiccation and occlusal microtrauma for several months. Hence, GI can mature in optimised conditions [1]. GIs, which have long required hand-mixing of the powder and liquid, are today presented in a capsule, which saves time, is easier to use and improves the quality of the mixture.

An acid-base reaction

During the first phase, the H^+ ions of the acid attack the surface of the glass particles, liberating in particular the calcium and aluminium ions. The ion release is facilitated by the tartaric acid which forms complexes between them. A polysalt is thus created that hardens gradually [5].
It should be noted that in a clinical setting, the GI has a glossy appearance during this phase. Humidity must be controlled, as this reticulation phenomenon is not stable. The mechanical properties would therefore be altered by desiccation or, in contrast, by excessive moisture addition. The GI should not be manipulated during this phase in order not to disturb the chemical bond. Phase two entails gelation of the material. It becomes matt, at which point it can be shaped (Fig. 1 and 2). The total time of the procedure is around three minutes, but this can vary depending on the type of GI and the manufacturer. Phase three entails maturation of the material. LVGIs required almost one year to reach the mechanical properties of a composite. This time has been reduced to a few hours for the latest generation of GIs.

Unique and numerous properties

One of the main benefits of these materials is their natural adhesion to dental tissues. This adhesion takes place through the ionic reaction of the carboxylate groups on the polyacid molecules with the phosphate ions from the tooth surface [4] and with the charged positive ions of the hydroxyapatite. An interfacial ion-exchange layer is formed. In clinical practice, this intrinsic adhesion obviates the need to use an adhesive. Nevertheless, in order to improve micro-mechanical adhesion, the use of a conditioner is recommended for treating the tooth surface. The latter reduces surface tension, eliminates the smear layer and partially demineralises the dentinal tubules. The wetting of the glass ionomer will be improved. This surface treatment is composed of a polyacrylic acid with concentrations between 10 and 20% for an application time of 10 to 20 seconds, depending on the dilution. This conditioner has become redundant for the latest generation of glass ionomers HDGI, which is intrinsically more acidic and does not require this usage. However, this information should be treated with care, as although the adhesion values remain comparable in the short term, this is not the case after six months, especially since the conditioner contributes to a reinforcement of the seal [6]. In contrast, its use is truly recommended when placing GI-based sealants in order to ensure their longevity. An excellent seal, which is an essential factor in avoiding pulp inflammation, is also ensured by low levels of polymerisation shrinkage. In addition, the incomplete opening of the tubules by the conditioner limits the occurrence of post-operative hypersensitivity. This seal, combined with the physico-chemical properties of the materials, leads to remineralisation of the tooth [7]. GIs are therefore biocompatible and bioactive materials thanks to the release of fluoride, in particular during the first months after their placement, which provides them anti-caries properties.

Figure 1: Glass ionomer with a shiny appearance once placed in the cavity.

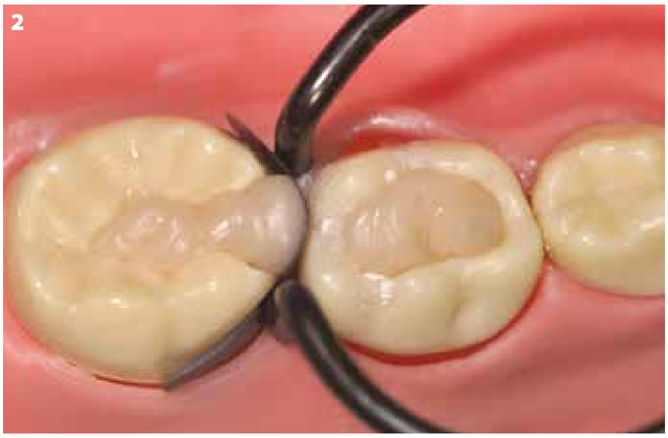

Figure 2: Progressive gelation of glass ionomer. It can be shaped when it turns matt.

But what about the true mechanical qualities?

These have significantly increased with the arrival of impregnated, protected HVGI, especially due to the increase in the number of fillers and the variability of their size. The placement of a thin protective coating (35 to 40 µm) increases the GI's hardness and resistance to wear, while also protecting it from moisture contamination [8]. Studies comparing amalgam restorations with GI restorations on deciduous teeth have demonstrated similar survival rates over two years [9]. Randomised clinical studies comparing restorations on permanent or deciduous teeth showed that there is no significant difference between the survival rates of HVGI and amalgam for periods over six years [10]. Other studies showed similar results when posterior restorations with composite and glass ionomer were compared over four years [11].

The results of these studies justify the use of GIs for occlusal cavities, cervical lesions and small-sized proximal restorations. One six-year study examining the restoration of 1,231 Class II cavities in deciduous teeth presented a success rate of 97.42% [12]. However, creating larger proximal cavities or mesial-occlusal-distal cavities increased the risk of fractures [13]. Restoring cavities in direct contact with heavy occlusal forces alters the durability of the restoration and explains the contraindication against restoring the cusp with this type of material. As far as placing sealants is concerned, Liu demonstrated that there is no difference at 24 months in the ability of a composite resin and a GI to prevent the occurrence of sulcus caries [14]. Mickenautsch evidenced in a systematic review of the literature that there are no significant differences in terms of preventing carious lesions at 48 months in comparison with a composite resin-based sealant, which is often considered as the reference [15]. Additional studies should be conducted to confirm these results over a longer term.
In order to improve the clinical longevity of restorations, two elements in particular should be considered: cavity preparation and the use of a coating. Soft cavities with rounded angles are sought to prioritise saving tissue that, however, present sufficient base to favour the occurrence secondary caries, in particular on primary deciduous molars, which have a strong cervical constriction (Fig. 3).

Figure 3: Preparation for glass ionomer presenting a secondary cavity to ensure a maximum base.

Figure 4: Placement of a Lumicontrast® sectional matrix (Polydentia).

The use of a coating increases the mechanical properties of the GI [4, 16]. Its use is nevertheless disputed in deciduous teeth. In fact, when their presence in the mouth is limited, it can be prudent in terms of biocompatibility to avoid the use of surface resin when the restorative material does not contain it. In this case, it can be replaced by a cocoa butter type of product (GC), which means humidity can be controlled during the first maturation phases.

Clinical indications

The spectrum of indications of GIs in paediatric dentistry is extremely varied: sealants, restorations of cervical lesions, temporary or permanent anterior restorations (choice of shade varies depending on the manufacturer), restorations of occlusal cavities, small proximal cavities [17], pulp protection and treatment of deep carious lesions, structural defects [18], traumas, and so on. Their use is indicated both for deciduous dentition and immature or mature permanent dentition. Condensable glass ionomers are an excellent alternative to amalgam [19], and also to composites in terms of biocompatibility. Although the material is reputed to possess low technique-sensitivity, operating protocols must be followed. Indeed, many failures stem from non-compliance with the working time, a poor choice of matrix, poorly adapted preparation or injection of an inadequate amount of material leading to air bubbles or issues with the seal. Humidity must also be controlled to guarantee that restorations will last. The use of a dam is optional but, as well as controlling humidity, using one provides greater comfort to both the young patient and the practitioner. The quality of the matrix is crucial for the success of the restoration (Fig. 4).

Figures 5 to 12 show the placement of a sealant on 36 using Fuji Triage from GC with the press finger technique. The latter enables the material to penetrate into pits and fissures thanks to controlled pressure on the occlusal surface.

Figure 5: Material required to place a sealant using the press finger technique (glass ionomer, Fuji Triage®, GC).

Figure 6: Pre-operative view of 36.

Figure 7: Cleaning of the sulcus.

Figure 8: Application of cavity conditioner (GC) for 10 seconds, gentle rinsing and drying.

Figure 9: Placement of Fuji Triage® (GC).

Figure 10: Application of cocoa butter on the tip of the index finger.

Figure 11: Pressing the index finger onto the occlusal surface of 36 to ensure that the GI penetrates into the pits and fissures. Removal of excess.

Figure 12: Post-operative view.

Conclusion

Glass ionomers should take on an increasingly significant role in our treatment strategies. Long criticised for their lack of mechanical strength and their poor aesthetic qualities, the latest generations of GIs (high-viscosity GIs and high-density GIs, associated with a surface treatment) are excellent alternatives to amalgam or composite resins. These biocompatible materials can be used for impermeable, durable restorations that limit the recurrence of caries. They perfectly meet the challenges of minimally invasive dentistry, save dental tissue and preserve pulp vitality.

KEY POINTS

- Glass ionomers are biocompatible materials that are intrinsicly adhesive.
- Using a coating improves the mechanical and aesthetic qualities.
- Glass ionomers have multiple indications, both in deciduous and permanent teeth.
- Glass ionomers constitute, depending on the clinical situation, an alternative to both amalgam and composites.
- The press finger technique can be used to seal pits and sulci quickly.

Test your knowledge

1. Glass ionomers contain glass particles and bisphenol........ **True/False**
2. High-density glass ionomers are packable........ **True/False**
3. The thickness of the 'coating' exceeds 180 µm........ **True/False**
4. The use of 37% phosphoric acid is required before the insertion of glass ionomer........ **True/False**
5. The longevity of a glass ionomer restoration is on average 2 years .... **True/False**
6. Glass ionomers have the ability to release fluoride, which provide them anticariogenic properties........ **True/False**

1. False / 2. True / 3. False / 4. False / 5. False / 6. True

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Prof. Márk Fráter graduated "Summa Com Laude" as a dentist from the University of Szeged, Hungary in 2010. In 2015 he obtained his PhD at the same university with the topic: 'The restorative use of fibre-reinforced materials in the posterior region'. One year later he became a specialist in Restorative Dentistry and Prosthodontics. He currently has a private practice in Szeged and also works in a practice in London, with an emphasis on endodontics, conservative and restorative dentistry. Currently, he is Assistant Professor and acting head of the Department of Operative and Aesthetic Dentistry at the University of Szeged. He also regularly gives lectures and hands-on courses in endodontics and restorative dentistry for dentists. He is a board member of the Hungarian Society of Aesthetic and Restorative Dentistry and the GC Prosthodontic Advisory Board.

Dr. András Forster, M.Sc
Dr. András Forster graduated as a dentist at the University of Szeged in 2006 and became a specialist in restorative dentistry and prosthodontics in 2009. Since then, he is working at the Department of Operative and Aesthetic Dentistry, currently as a research fellow. He has worked at renowned private practices in Budapest and London. Since 2016 he works as a prosthodontist in the Urban Regeneration Institute in Budapest and the British Hungarian Medical Service. He gives hands-on courses on a regular base in Hungary and abroad. Next to his clinical work András Forster also engages in scientific activities, having co-authored several peer-reviewed publications. In 2017 he was elected board member and secretary of the Hungarian Society of Aesthetic and Restorative Dentistry.

New Generation Short Fibre-Reinforced Composite Restorations of the Posterior Dentition

Márk Fráter DMD, **András Forster** DMD

Finding the ideal material(s) for the restoration of posterior teeth, with the aim of re-establishing the original mastication, has long been a central issue in restorative dentistry. Direct restorations have been widely applied to restore posterior teeth due to their low cost, the smaller amount of healthy tooth substance that has to be removed as compared to indirect restorations, and their acceptable clinical performance [1]. **Two main causes of posterior restoration failure have been identified: secondary caries and fracture (either of the restoration or the tooth itself)** [2,3]. The later phenomena is a result of multiple factors.

Dental fracture patterns depend on the direction and amount of force applied, and the ability of the tooth to recover from the deformation [4]. Force may be relatively light and repetitive, as in normal mastication, or relatively heavy and repetitive as seen in bruxism, and extremely heavy and sudden in cases of trauma. In the posterior region, forces range from 8 to 880N during normal mastication [5]. Extreme forces can easily lead to crack development in restored teeth, but this can also be true in case of physiological forces applied on the long term. In the "amalgam era" [6] the belief was that the harder the material chosen for restorative purposes, the more chances it had to prevent crack and fracture occurrence. **Conversely, according to biomimetic dentistry there is no need for rigid materials. The primary aim is to substitute the missing hard dental tissues (enamel and dentin) with restorative materials closely resembling the natural tissues regarding their mechanical features and properties** [7].
According to the early research of Pascal Magne, the ideal materials to replace the brittle, yet stiff enamel should be feldspathic porcelain or highly filled, laboratory composite, whereas the substitution of dentin should be performed with microhybrid composite resin [8]. From the year 2000 **several studies emphasised the importance of a third type of tissue (or layer): the dentino-enamel junction (DEJ)** (Figure 1) [8,9].
The DEJ has been histologically described as a collagenous interphase between these two bio-mechanically vastly different tissues, partly connecting and unifying them, and partly forming a stress-absorbing layer protecting the underlying elastic dentin and the vital pulpal tissues. This is the reason why multiple cracks can be seen in the enamel of aged teeth, yet they rarely reach and compromise the supporting dentinal base, therefore usually remain asymptomatic. So far, this latter function of the DEJ has not been successfully mimicked by any restorative material. The excellent biomechanical properties of the DEJ can divert and blunt enamel cracks through considerable plastic deformation, providing a functional shielding mechanism and allowing synergy between enamel and dentin. This is the mechanism that enables these natural tissues to withstand a lifetime of mastication. **Therefore, the DEJ might be considered a specialised tissue type of its own right, serving a fundamental function, and when restoring a tooth according to biomimetic principles one should also consider this layer - not only dentin and enamel.**

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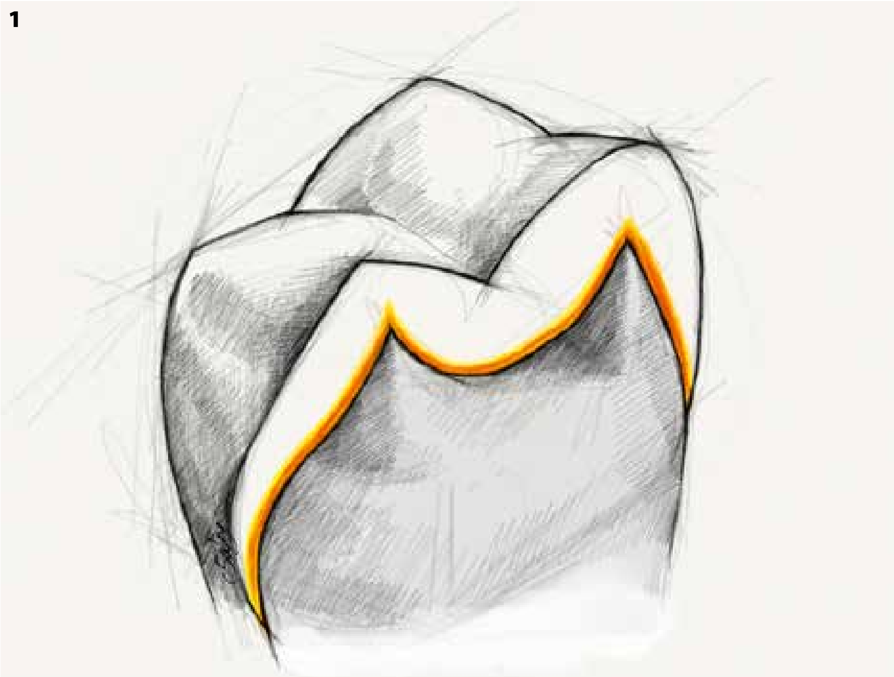

Figure 1: Illustration of a molar showing the natural changes of enamel thickness, the natural histoanatomy of the dentin and the position of the dentino-enamel junction.
Illustration by Dr. Tekla Sáry.

In 2013, **a short fibre-reinforced composite (SFRC) (everX Posterior, GC) was introduced to the market with the goal to substitute the missing dentin with a material having a similar behaviour; additionally, the material has clinically shown to be also able to mimic the stress-absorbing properties of the DEJ** simultaneously. Fibre-reinforced composites have been used in dentistry for the past 30 years but their true potential and function is just being realised.
The reinforcing effect of the fibre

Figure 2: The unique size of the short fibres is visible when the SFRC material is extruded from the unitip.

fillers is based on stress transfer from the polymer matrix to the fibres [10], which is influenced by the size of the fibres and the connection between the fibres and the matrix. The actual average size of the glass fibres in the SFRC material is 1-2 mm, thus exceeding the critical fibre length and making stress transfer possible (Figure 2). Additionally the fibres are silanised and are therefore able to chemically connect to the matrix. **As a consequence of these features, the SFRC is able to reinforce the dental structures even in case of extreme loading conditions.** Since these fibres show random orientation, they can reduce the polymerisation stress generated by the composite resin in all directions [11,12]. This makes it possible to use the material in layers up to 4mm. However, the in vitro research carried out by the authors has shown that everX Posterior applied in 2-3mm thick layers with oblique layering gave the best results regarding the fracture resistance of posterior molar teeth among the restored groups [13]. Furthermore, this technique showed the highest number of repairable fractures once fracture occurred. Thus this technique (2-3 mm thick layers with oblique layering) seems to be the most beneficial.

When following the biomimetic restorative principles, the indications for the usage of everX Posterior are dentin substitution in medium and large cavities in posterior teeth, which means that in practice the surfaces of these modern direct restorations should be made of microhybrid or nanohybrid composite covering the SFRC "dentinal core" in at least 1 mm thickness everywhere. **The other revolutionary indication of SFRC is in case of indirect restorations or repair of damaged restorations.** The SFRC material contains a semi-interpenetrating polymer matrix (semi-IPN), which consists of both linear and cross-linked polymer phases. The linear phase can be dissolved if a suitable adhesive resin is added on its surface, thus enabling the reactivation of the material and also true chemical bonding to it [14]. Unfortunately this is not the case with conventional composite resins, because once the active oxygen inhibition layer is lost from their surface, the cross-linked polymers cannot be broken up anymore. This leads to little if any reactivity left for free radical polymerisation bonding and therefore, no actual chemical bonding can take place. This unique structure leads to the fact that **if the core build-up is made with the usage of SFRC, this layer will not only act as a stress-absorber and crack stopper interphase, but will also have the ability to chemically adhere to the indirect restoration placed on it, if adhesive cementation is applied.** In clinical settings this can be managed with the following steps: first cleaning the surface from any debris or biofilm, and then applying a pure resin bonding agent (eg. GC StickRESIN).

With the above mentioned unique features, everX Posterior brings the restorative possibilities in the posterior region to a new level, and also opens new horizons for future restorative techniques. Therefore it seems justified to state that SFRC materials will shortly change the face of posterior restorative procedures.

Clinical case report: Restoring tooth 16 according to biomimetic principles with everX Posterior and a GRADIA® PLUS overlay.

After removing an old, cracked MOD composite filling, the form was optimised and the dentin and DEJ were substituted using a SFRC as core build-up. The missing enamel shell was then restored with a GRADIA® PLUS overlay.

Figure 1: Initial situation showing an MOD composite restoration with a vertical crack inside the filling causing pain for the patient

Figure 2: Prepared cavity

Figure 3: Core build-up with SFRC (everX Posterior, GC)

Figure 4: Situation before impression-taking

Figure 5: GRADIA® PLUS overlay

Figure 6: Before adhesive cementation

Figure 7: After adhesive cementation

Clinical case report: Restoring tooth 15 with a direct fibre-reinforced composite restoration.

The patient presented with a distal carious lesion on tooth 15. After preparation and cleaning, a matrix was placed and the OD cavity was transformed into a Class I by building up the approximal wall with Essentia Universal composite (GC), according to the centripetal technique. The internal missing dentin was then substituted with a SFRC (everX Posterior, GC) and occlusally covered with a layer of microhybrid composite (Essentia Universal).

Figure 1: Initial situation showing distal change of transparency indicating caries.

Figure 2: Prepared OD cavity

Figure 3: Placing a sectional matrix

Figure 4: Building up the interproximal wall with a microhybrid composite (Essentia Universal, GC)

Figure 5: Substituting the missing dentin with a SFRC (everX Posterior, GC)

Figure 6: Final restoration after finishing - SFRC covered with microhybrid composite (Essentia Universal) occlusally

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Challenging aesthetic restorations: combining materials from a different nature

by **Dr. Silvia Del Cid, Spain**

Dr. Silvia Del Cid
Silvia Del Cid graduated in 1999 as a dentist at the University of Granada. She further specialised by enrolling in a Master in Conservative Dentistry and Endodontics at the University Institution Mississippi between 1999 and 2001. Her diploma of Oral Implantology and Implant Prosthesics, obtained in 2006, is supported by the European Implantology Forum. In 2013, she received a Diploma in Occlusion and Diagnosis in Oral Rehabilitation. from Dr. Aníbal Alonso. She is a speaker in demand at national conferences and hosts practical courses about layering techniques.

Currently, one of the major challenges in Aesthetic Dentistry is the requirement to combine materials from a different nature and with different optical properties in order to deal with clinical situations that require predictable aesthetic results, this while following the principles of maximum conservation of the dental structure.

The latest developments in materials for dentists and dental technicians allow us to handle complex cases with the best aesthetic outcome and durable results, as shown in the following case report.

A 55-year-old patient came to the clinic because she was not satisfied with the aesthetic appearance of her teeth due to a defective crown on tooth 21 and diastema closure with composite on tooth 11, 12, 13 and 22 because of a periodontal disease, now stabilised. The patient had previously had an external whitening (Figures 1 and 2).
We observed discolouration, marginal flaws, overcontouring and a dull aspect of the composites. We suggested the patient to replace the crown in 21 and the composite restorations in 11, 12, 13 and 22, without making veneers, as an option of minimum intervention. The patient agreed with the treatment plan.
I contacted Carlos de Gracia, dental technician, and we planned which material would be the most appropriate to restore tooth 21. We decided first to restore tooth 11, 12, 13 and 22 with direct composite chairside and then proceeded to make the crown in the laboratory.

Figure 1: Frontal view of the patient

Figure 2: Lateral view of the patient

In order to get an optimal integration of the restorations in their surroundings, it is fundamental to respect the following parameters: shape, size, surface texture, value and translucency of the natural tooth. Shade and colour saturation are of secondary importance from the point of view of the final integration. It emerges from all this that in order to get an optimal aesthetic integration, the technique and expertise of the operator are more important than the properties of the materials used.

Shade selection and cavity preparation:

In order to determine the shade, we used the Try Button technique. A sample of each dentin shade was applied directly on the clean tooth surface and light-cured. The process was repeated with enamel shades on the incisal third in extension towards the free edge. **This should always be done before isolation placement so that dehydration and the subsequent change in shade is prevented** (Figure 3).
Polarised light was used to obtain a more accurate interpretation of the colour by eliminating the specular highlights in the image, facilitating the visualisation of the different intensities and opacities of the tooth.
In this case, the composite Essentia (GC) was selected. This composite has the feature of having a different composition for enamel (nanohybrid) and dentin (microhybrid), which allows for a greater dispersion of the light due to its different refractive indexes.
The selected colours based on the Try Button technique were: Essentia Light Enamel (LE) for the palatal walls, Essentia Light Dentin (LD) for cervical and middle third and Essentia Light Enamel (LE) for vestibular and interproximal

Figure 3: Shade determination using the Try Button method with different enamel and dentin pastes

Figure 4: Same view as in Figure 3 with polarised light

Figure 5: Complete isolation of the operative field

Figure 6: Bevelled and smoothened enamel for an increased bonding

enamel.
The accurate selection of the colour can be seen in the photograph with polarised light (Figure 4).

Next, the operative field was isolated completely (Figure 5) and surfaces to be prepared were cleaned in order to remove the biofilm and to improve the subsequent bonding process. Rubber cups and pumice paste were used for this cleaning step.
For the cavity preparation, the old restorations were removed first. Then, the aprismatic enamel was removed and the cavity margins were smoothened in order to optimise the surface for bonding (Figure 6). For the reconstruction of the anatomy of the interproximal cavity walls, metallic sectional matrixes (Composi-Tight, Garrison) were used (Figure 7).

The bonding procedure as the key step

The aesthetic demand of patients is growing, and this sometimes means that key steps in the restorative procedure which do not have an immediate impact on aesthetics (such as bonding) may seem less important to practitioners.
My professional experience has shown me that **most of failures in composite restorations are caused by mistakes during the bonding process**.
According to me, bonding is the most important and crucial procedure step in the restorative procedure when using resin composites. The main objective is to create a stable hybrid layer which will not degrade over time. Hence, it is crucial to use a dental adhesive system that does not contain hydrophilic monomers (e.g. HEMA) that tend to trigger this degradation.
We also consider it of utmost importance that the chosen adhesive contains 10-MDP monomers, which improves stability of the hybrid layer over time, allowing a mechanical and chemical bond unlike traditional systems.
I prefer the self-etching technique: selective etching on enamel with orthophosphoric acid 35-37% during 10-15 seconds (depending on the pH of the adhesive system used) (Figure 8) and subsequent application of a self-etch adhesive on the enamel and the dentin in order to avoid routinely acid etching the dentin and triggering the release of matrix metalloproteinases (MMPs). It is important to ensure the complete removal of the residues of orthophosphoric acid through aspiration and rinsing during at least 15 seconds before continuing with the following step.
We applied G-Premio BOND on enamel and dentin during 15 seconds, rubbing the adhesive with a brush. In order to remove the solvent completely (one of the main reasons of the degradation of the hybrid layer) (Figure 9), the adhesive is dried with air for 5 seconds... before light curing for 20 seconds.

Figure 7: Sectional matrices for the reconstruction of the interproximal walls

Figure 8: Selective enamel etching

Figure 9: Application of the universal adhesive G-Premio BOND

Figure 10: Application of Essentia LE on the palatal and interproximal walls and Essentia Masking liner to mask the discolouration of the cervical third

Figure 11: Application of Essentia LD with a greater opacity, respecting the space for the vestibular enamel and not invading interproximal zones

Figure 12: Application of vestibular enamel with Essentia LE

Composite layering process

One of the current trends in dentistry is the simplification of the layering technique. **The composite Essentia (GC), which was selected for this case, allows to simplify layering with composite as much as possible through bilaminar technique (2 layers).** Due to the different composition of enamel (nanohybrid) and dentin (microhybrid), the light is dispersed in a natural way thanks to different refraction indexes.

We first restored palatal and interproximal walls with Essentia LE. In order to mask the change of colour of the cervical third on tooth 11, we also used a thin layer of Essentia Masking Liner (ML). This shade is interesting because it is more translucent than standard opaquers and does not completely block the light, resulting in a more natural final restoration (Figure 10).

Essentia LD was used to restore the dentin in the cervical and middle third, because of its adequate level of opacity (more opaque than other dentins). It respects the space for the vestibular enamel and does not invade the interproximal zone (Figure 11).

The vestibular enamel was restored with Essentia LE (more opaque and with a higher value than the Dark Enamel DE). We then light-cured the restorations under glycerine gel in order to remove the oxygen-inhibited layer and get a greater conversion factor on the surface (Figure 12). After finalising the shape and morphology, we proceeded to the creation of surface texture and the polishing steps. In this case a coarse-grit polishing disc (Sof-Lex, 3M) and Astropol/Astrobrush polishing systems (Ivoclar Vivadent) were used (Figure 13).

Figure 14 shows the fully rehydrated restorations on tooth 11, 12 and 13 with the provisional crown on tooth 21 in anticipation of the laboratory work.

Figure 13: Surface texture after finishing and polishing

Figure 14: Rehydrated restorations of tooth 11, 12, 13 and provisional crown in 21 in anticipation of the laboratory work.

Figure 15: Initial situation with discoloured tooth stump for the Initial Zr crown

Figure 16: Colour comparison between the Initial Zr crown and the sample button of Essentia composite

Figure 17: Finished crown on the model

Laboratory stage: fabrication of the zirconia crown

We sent the photographs of the initial situation as well as the ones taken with polarised light to the dental technician Carlos de Gracia. As shown in Figure 15, the metal core build-up was not in a favourable condition.
The milled substructure of Initial Zirconia Disk was layered with the different Initial Zr pastes (Inside, enamel, CLF, Opalescent…) in order to reproduce the colour of the adjacent teeth.
As a colour reference, we also sent him a composite button made of Essentia composite during the clinical phase (Figure 16).
The opalescence of the finished crown is shown in Figure 17. We then proceeded to the luting phase with a an adhesive resin cement (G-CEM LinkForce, Translucent; GC). Figure 18 shows the final situation after cementation.

Figure 18: Final situation after the Initial Zr crown was cemented on tooth 21

The handling of the materials we currently have at the clinic and the laboratory allows us to solve complex situations , like in the above case report. Even starting from an unfavourable situation, excellent aesthetic results can be obtained.


Aesthetics brought
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Essentia™
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Essentia represents
the pure essence
of composite layering.
With just seven syringes,
you now have a
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GC

Choosing the right luting agent for each indication

The long-term success of your restoration depends largely on the proper selection and the correct application of the luting agent. In the latest years, the number of restorative materials as well as luting agents has increased considerably. Since there is no ideal luting agent that meets all requirements for every indication, the choice should depend on physical and adhesive properties, aesthetic needs, technique sensitivity and the scientific evidence available for each specific case.

Find the answer in a few clicks!

To make this process easier for the dentist, GC has developed the GC Luting Guide, which is available, free of charge, as an application for Android or iOS. Based on the restoration design, material and the clinical circumstances, the application helps to select the most appropriate luting solution (Figs. 1-3). Other options that meet the requirements are displayed as well. Based on these parameters, each dentist can decide for himself which cements should be available in his practice.

Next to the selection of the luting agent, its correct use is imperative. Great variations in physical properties may exist from improper manipulation of the material. The GC Luting Guide describes each clinical step in detail, from start to end, beautifully illustrated with clear images. In just a few clicks, the clinician can be confident about his luting process. The GC Luting Guide is a useful tool in dental education, for starting prosthodontists and for any dentist who wants to remain informed about the best luting options.

Figure 1: All parameters can be selected one one screen.

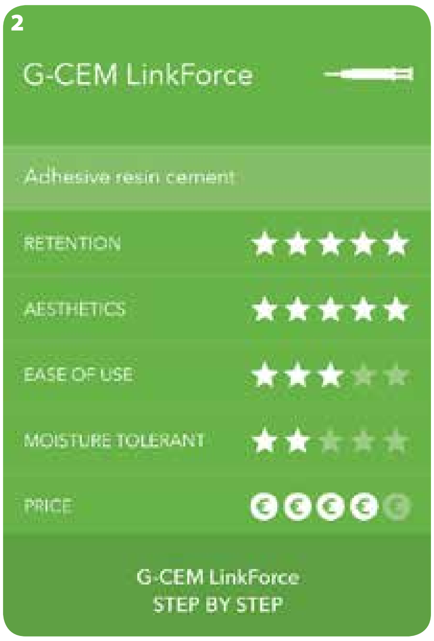

Figure 2: The Luting Guide suggests the most appropriate option from the "High Five" luting solutions. The type and main features of the suggested luting agent are shown.

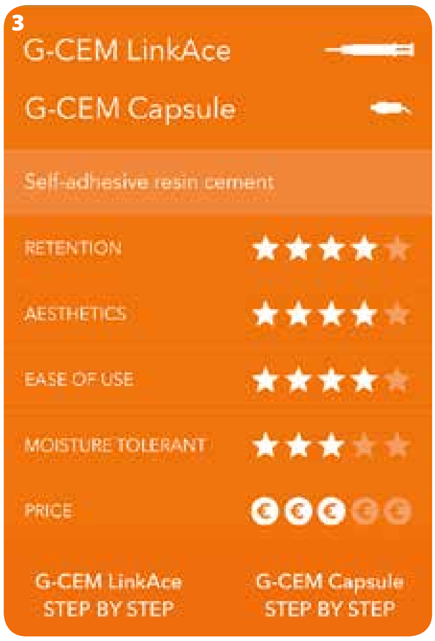

Figure 3: The user can swipe to see alternative options and their features.

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