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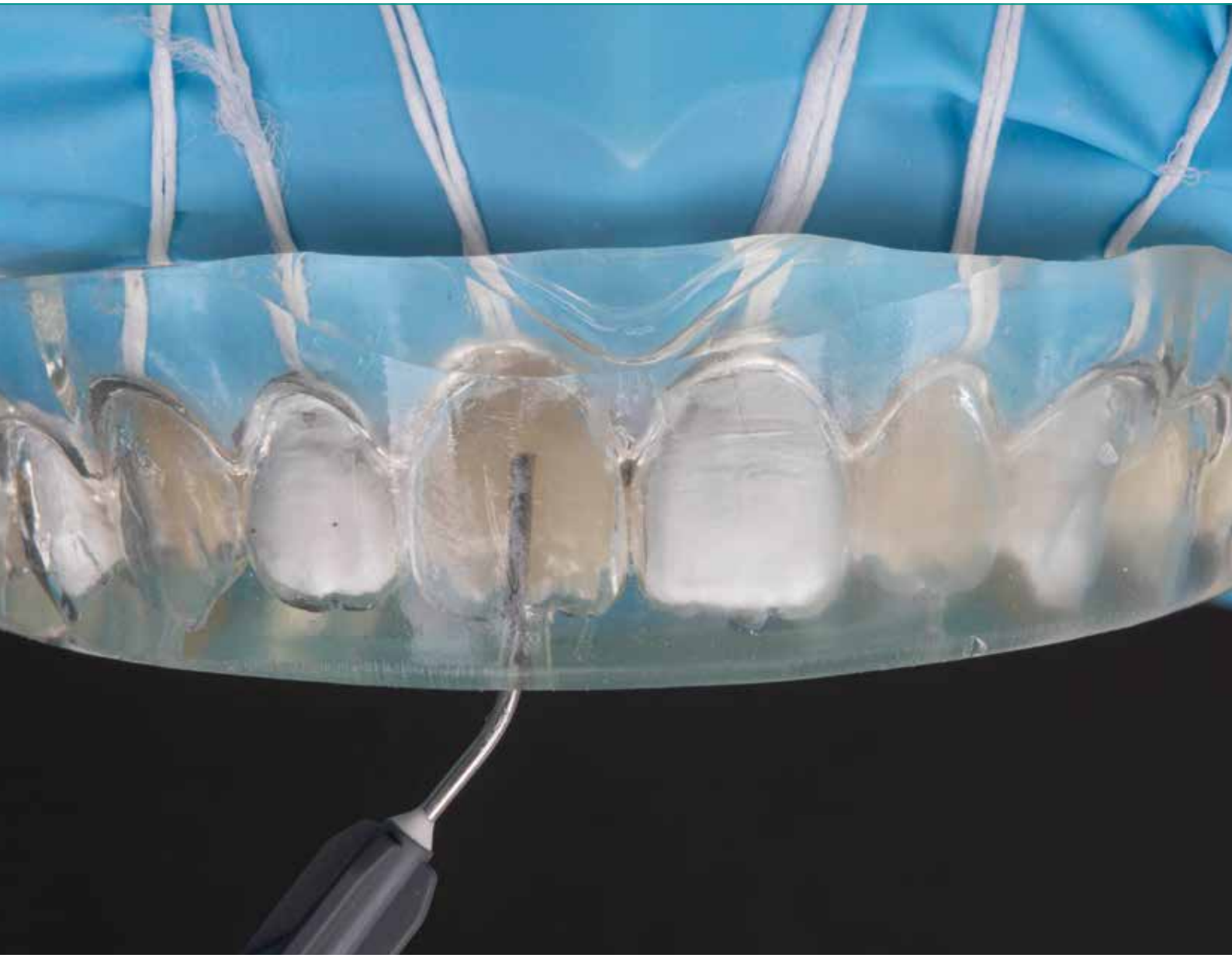
2023

Special edition

Injection moulding technique



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Dear reader,

Injection moulding is a contemporary technique in dentistry, which enables to reproduce a detailed morphology in a quick way. For this technique, a transparent matrix is used (EXACLEAR), through which the composite can be cured without leaving an oxygen inhibition layer. With the minimally invasive cavity preparation, the resultant space needs to be filled with a composite with a consistency that is situated between paste-like and flowable. World-leading technologies have enabled GC to define a new benchmark in composite: G-ænial Universal Injectable, an injectable composite offering exceptional strength, polishability and aesthetics, also ideally suited for this technique. It's a new paradigm in thinking that a composite with a more flowable consistency is actually your strongest option!

Josef Richter

Chief Operating Officer & President
GC Europe AG

Injection moulding with composite to obtain a predictable aesthetic outcome

Clinical step-by-step with G-ænial® Universal Injectable and EXACLEAR transparent silicone

By **Dr. Ali Salehi**, France

Dr. Ali Salehi *graduated in 2007 as a Master in Dentistry at the Faculty of Dental Medicine of Strasbourg University, France. During his Master course, he completed an Erasmus internship at the Faculty of Dentistry of the Johannes Gutenberg University in Mainz, Germany. From 2008 until 2015, he worked as a clinical consultant at the Department of Prosthetics of the University of Strasbourg. Since December 2015, he became a part-time Clinical-University Assistant in the same department. In parallel, he also works in his private practice in Strasbourg since 2011. His clinical work has been honored with several prizes, such as the 1st prize in the clinical category of the "European Talent Awards" of 3M ESPE (2015) , the 3rd prize in the "Essentia European Facebook contest" of GC (2016) and the 1st prize at the Grand Prix of Aesthetic Dentistry of the French dental journal "Réalités Cliniques" (2017). Dr Salehi also actively participates in many trainings & conferences at various national and international events. His main topics of interest include dental photography, aesthetic dentistry, adhesive dentistry and minimally invasive dentistry.*

Using the injection moulding technique, composite restorations are created by injecting the composite into a silicone key that is directly positioned into the patient's mouth. The main advantage of this technique is that restorations can be first modelled in wax on a stone model, and then copied and transferred in detail to the natural teeth. **For complex morphologies, challenging aesthetic cases or cases requiring reestablishment of the occlusal vertical dimension, a predictable result can be obtained and chair time reduced with this relatively simple procedure. Adjustments can also be made afterwards if needed**. Because these restorative treatments usually comprise extensive surfaces, the composite used should be strong and wear resistant enough and also offer the desired optical properties. G-ænial Universal Injectable is an ideal product for this indication thanks to its great thixotropy and excellent mechanical & aesthetic properties.

Fig. 1-2: Initial situation.

A 34-year-old, pregnant woman came to the dental office with the request to improve the aesthetic appearance of her smile. Her chief complaint concerned the shape of the lateral incisors (Fig. 1-2). She had already undergone a bleaching treatment and two veneer-lays on the heavily discoloured teeth 14 and 15, due to endodontic treatments covered with voluminous amalgam restorations in the past. After explaining the different options, she decided to go for a treatment with direct composites because of financial reasons and the idea of the minimally invasive nature of the procedure.

A wax-up was made of the desired tooth morphology that had been defined in consultation with the patient (Fig. 3). Next, a non-perforated metal impression tray was filled with a transparent vinyl polysiloxane material (EXACLEAR, GC) and placed over the stone model with the wax-up (Fig. 4-5). The tray's only purpose being to be used as a mould to create the key, a full-arch tray with a smooth inner surface was selected so that the silicone could be retrieved easily in its whole and without damage (Fig. 6-7). Care was taken not to press too hard, so that all incisal edges were covered with a sufficiently thick layer in order to avoid potential tearing or deformation which could lead to a bad reproduction of the wax-up in the mouth of the patient. The tray was sufficiently filled to cover all teeth, up to the second premolars. As a rule of thumb, the silicone key should always extend so far that it includes at least two teeth distally from the teeth to be treated on both sides; this ensures stability of the key when it is positioned in the mouth and a proper reproduction of the aesthetic project for a more predictable final result. In this regard, it should be noted that in a more ideal situation, a rubber dam could be used. In this case, the teeth should be sufficiently exposed through the dam and the clamps placed distally enough to avoid interference with the key. The latter should be trimmed cervically to allow proper seating without any

Fig. 3: A wax-up was made in consultation with the patient.

Fig. 4-7: A metal impression tray was filled with transparent vinyl polysiloxane (EXACLEAR, GC) and used to copy the stone model with the wax-up.

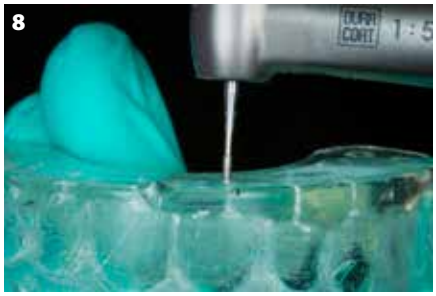

Fig. 8: A needle-shaped bur was used to drill holes through the silicone key ending in the middle of the incisal edge.

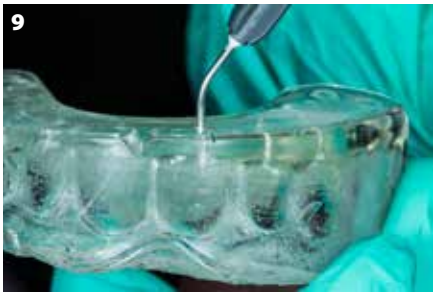

Fig. 9: It was checked whether the holes were large enough to enable the tip of the composite syringe to pass easily and completely.

tension between the key and the rubber dam.

A fine, needle-shaped bur was used to drill the holes in the key through which the composite will be injected (Fig. 8). These holes were positioned at the middle of the incisal edge of each tooth, half-way between the distal & mesial borders, and made as small as possible but large enough to enable the tip of the composite syringe to pass easily and completely (Fig. 9). Care was taken not to damage the vestibular part inside the silicone key with the bur, to maintain the information of surface texture that had been created during the wax-up. This will guarantee a proper transfer and respect the idea of a predictable final aesthetic result.

After cleaning, the procedure was started with a central incisor. The neighbouring teeth were isolated with Teflon tape (Fig. 10). Then, the enamel was etched (Fig. 11) to create extra micromechanical retention, carefully rinsed and dried. A frosty appearance of the surface was obtained (Fig. 12). A universal adhesive (G-Premio BOND, GC) was applied, left undisturbed for 10 seconds and thoroughly dried with maximum air pressure for 5 seconds before light-curing (Fig. 13).

Fig. 10: Neighbouring teeth 11 and 22 were isolated using Teflon tape.

Fig. 11: The enamel of tooth 21 was etched to enhance micromechanical retention.

Fig. 12: After etching, the enamel surface showed a matt appearance.

Fig. 13: The universal adhesive G-Premio BOND (GC) was applied in accordance with the manufacturer's instructions and light-cured.

Fig. 14: G-ænial Universal Injectable (GC) was injected into the silicone key.

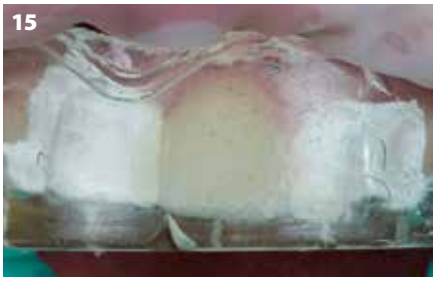

Fig. 15: Due to the high transparency of the key, it can be visually checked if a sufficient amount of composite has been injected to cover the entire surface. The composite can also be easily light-cured through the key.

Fig. 16: The excess was removed with a scalpel (blade #12). Due to the presence of the Teflon tape, the excess did not stick to the neighbouring teeth and it was easy to remove.

Next, the silicone key was positioned onto the teeth and the composite was injected (Fig. 14). G-ænial Universal Injectable (GC), shade A1 was selected for the procedure because of its high filler load and wear-resistance. The syringe was placed in the hole and slightly orientated towards vestibular. During the injection, a little bit of overflow is needed to ensure that all small voids at the margins and interproximal spaces are filled. This can easily be verified through the transparent key (Fig. 15).

Next, G-ænial Universal Injectable was light-cured through the transparent silicone. After removal of the key, the excess was taken out with a surgical scalpel blade (blade #12, Swann-Morton; Fig. 16). Further finishing was done with a flame-shaped bur at the cervical margin, to correct any possible overcontouring, (Fig. 17) and with metal strips (New Metal Strips, GC) interproximally (Fig. 18). Metal strips are more rigid than transparent ones, which makes them more efficient and easier to use. Note that even though some bleeding might occur during this stage, finishing and polishing should be carried out thoroughly as smooth margins will help the gingiva to heal faster but also maintain the gingival health over time. The same procedure was repeated on the other incisors and the canines (Fig. 19-20).

Immediately after, it can be seen that the surface texture of the wax-up was transferred in detail to the direct veneers

Fig. 17: A flame-shaped finishing bur was used.

Fig. 18: Interproximally, the margins were finished with metal strips.

Fig. 19: The same procedure as shown for tooth 21 was repeated for the other teeth. Application of G-Premio BOND on tooth 12.

Fig. 20: Injection of G-ænial Universal Injectable (GC) into the EXACLEAR key.

Fig. 21-22: Result immediately after curing the composite.

Fig. 23-25: Gingival healing 3 days after the treatment.

Fig. 26-28: Final polishing was done at the recall session.

in the oral cavity, which gives the teeth a very natural and lifelike appearance (Fig. 21-22). Three days after the treatment, the gingival tissue had healed entirely (Fig. 23-25). In the recall session one week later, the surface was polished again with soft rubbers and cotton wheels with polishing paste (DiaPolisher Paste, GC) (Fig. 26-28), to enhance the gloss while preserving the texture (Fig. 29-30).

The injection moulding technique is an easy approach that allows to plan restorations with complex morphology in advance and copy them in a predictable manner to the clinical situation. Even the surface texture can be copied from the wax-up, which saves valuable chair-time. In order to have a long-lasting result, the composite needs to have good mechanical properties. **Considering the interesting properties of G-ænial Universal Injectable, being even stronger than many paste composites, it can be safely used for that purpose.**

Fig. 29-30: Result after final polishing.

Injection moulding for a predictable aesthetic outcome.

By **Dr. Angel Andonovski**, North Macedonia

Dr. Angel Andonovski *became a dental technician in 2012. In 2017, he graduated as a dentist at the University of St. Kiril and Metodij in Skopje, Macedonia. Thereafter, he started his 'Master in Prosthetic Dentistry' at the same university. In 2018, he received his license for general dentistry. That same year, he won the second price in the post-graduate category of the Essentia Academic Exellence Contest. Since 2012, he has been working as a dental technician and since 2018, he is working in one of the biggest dental clinics in Macedonia.*

Extensive treatment planning can be time-consuming. However, this time is often saved at the actual execution of the treatment plan. Meanwhile, the aesthetic outcome will be more predictable and the total procedure is less stressful, as part of the treatment can be done outside the mouth, in absence of the patient.

A 35-year-old woman consulted the practice because she was dissatisfied with the appearance of her frontal teeth. At the clinical assessment old restorations with marginal discolouration, a devitalised, darkened tooth #11 with a noticeable crack on the incisal surface and rotations of the lateral incisors and right canine were found. (Fig. 1).

Figure 1: Pre-operative intraoral view. Old restorations, cracks and discolourations are visible

Figure 2: After internal bleaching of tooth #11

Figure 3: After removal of the old restorations

Treatment options were discussed including the need for shape correction as well as slight colour adjustments. The patient refused the use of ceramics because of the treatment cost.

It was decided to treat the teeth with G-ænial Universal Injectable composite veneers using an injection moulding technique: it renders a predictable aesthetic result and is cost- and time-effective. G-ænial Universal Injectable has excellent physical properties and wear resistance: these are important properties to consider for the long-term outcome.

After internal bleaching of tooth #11 with sodium perborate, the tooth shade was similar to the adjacent teeth (Fig. 2). In the next session, the old restorations were replaced; simultaneously, the shape of the rotated teeth was corrected to achieve an ideal integration of the future veneers, which then could be made of uniform thickness with a predictable result (Figs. 3 and 4). Essentia Dark Dentin and Medium Enamel were used.

Thereafter, impressions were made. A wax-up was prepared on the model (Fig. 5). This allows to focus on proper shape and symmetry outside the mouth, which is always more practical. It also gives an indication of how thick the applied composite layer will be; in this case, only a thin enamel replacement layer was needed. As an additional benefit, the patient needs to spend less time in the dental chair. Based on this wax-up, a transparent silicone key was prepared with EXACLEAR (Fig. 6). Injection channels were created (Fig. 7), ending at the incisal edge, so the sprue could be easily removed without altering the shape of the restoration.

Figure 4: Smile after replacement of the old restorations

Figure 5: Wax-up of the frontal teeth

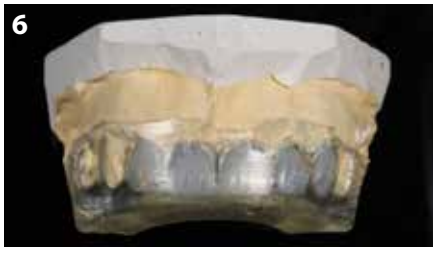

Figure 6: Transparent mould from EXACLEAR

Figure 7: Creation of the injection channels with the tip of the syringe

Figure 8: Frontal teeth were cleaned and slightly roughened

Figure 9: Frontal teeth were etched with phosphoric acid

Figure 10: Frosty appearance of the teeth after etching

Figure 11: Teflon tape was applied on the adjacent teeth

The day after the first treatment session, the patient returned. The teeth were cleaned and the frontal teeth in need of restoration were slightly roughened (Fig. 8). Next, they were etched with phosphoric acid (Fig. 9), leaving the typical frosty surface (Fig. 10). One by one, the teeth were isolated by separating them from the adjacent teeth using Teflon tape (Fig. 11).

G-Premio BOND was applied, left undisturbed and then strongly air-blown before polymerisation (Fig. 12a). The silicone key was seated into the mouth and G-ænial Universal Injectable (shade A2) was injected (Fig. 12b) and light-cured through it (Fig. 12c). After removing the silicone key (Fig. 12d), composite excesses could be easily removed with a sharp blade.

The EXACLEAR impression is very precise, so all the texture that was

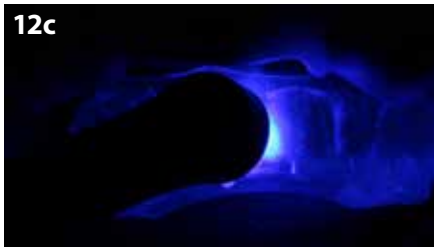

Figure 12: a) Bonding with G-Premio BOND; b) Injection of G-ænial Universal Injectable (Shade A2); c) Light-curing through the EXACLEAR mould d) After removal of the mould. Excess could be easily removed.

Figure 13: Intraoral view before polishing

being put in the wax-up could be replicated in the final restorations (Fig. 13). The finishing procedure is simplified in this technique; since shape and texture are already established and there is no sticky oxygen inhibition layer. All that was needed was some polishing with a goat hair wheel and a felt wheel with DiaPolisher Paste (Fig. 14). The results were predictable (Fig. 15), corresponding to the wax-up model and the rotations and colour differences were corrected. The smile line gently followed the lower lip line and a good aesthetic result was obtained.

Figure 14: Polishing with soft brushes

Figure 15: After treatment. a) Intraoral view; b) Smile

An efficient approach to the restoration of worn incisors

By **Dr. Florian Klumpp**, Germany

Dr. med. dent. Florian Klumpp
graduated in Dentistry at the Eberhard Karls Universität in Tübingen (Germany) in 2008. In 2010, he obtained his PhD "magna cum laude" with his dissertation, entitled "Comparison of BMP-4 versus BMP-2 for the osteogenic differentiation of periosteal cells". After having worked in different dental offices around Stuttgart, he now runs his own dental office in Metzingen (Germany).

The injection moulding technique with resin composite is a semidirect restorative procedure that enables a predictable translation of the diagnostic wax-up into composite restorations[1]. While this technique requires a more elaborate preparation, this time can be recovered again in the finishing phase. Moreover, more attention can be given to the functional aspects of the restorations, which are crucial for the long-term result.

Case report

A 28-year-old male patient visited the dental clinic because he was dissatisfied with the appearance of his upper front teeth (Fig. 1). Clinical examination revealed the presence of an old composite restoration on tooth 11 and excessive incisal wear of all maxillary incisors and the canines, with dentine exposure on the incisal edges (Fig. 2).

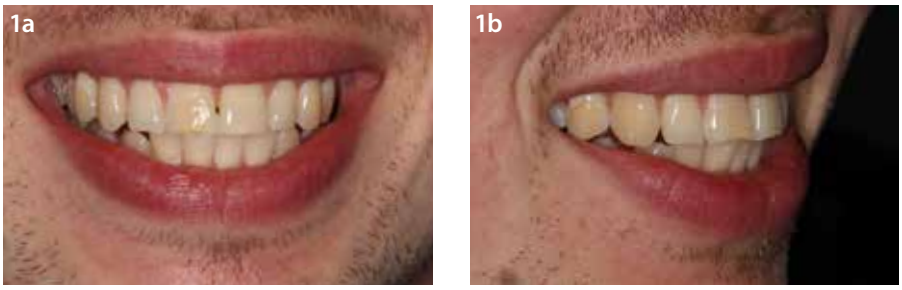

Fig. 1: Extraoral view of the initial situation. a) en face; b) oblique view. Note the excessive incisal wear

Fig. 2: Intraoral view of the initial situation

Fig. 3: Occlusal view of the mandible before treatment. Note the labioversion of tooth 41, which was triggering deflective interferences

Labioversion of tooth 41 caused a premature contact, triggering deflective interferences (Fig. 3). This was first corrected with a removable aligner.

Fig. 4: Tooth shade after bleaching

First, the teeth were whitened according to a home bleaching protocol with 6% hydrogen peroxide gel during 2-3 weeks to improve the shade and shade uniformity (Fig. 4).

When the diagnostic wax-up (Fig. 5) was created, the canines were shaped first and the canine guidance[2,3] was verified in the articulator. Owing to the disclusion during lateral and protrusive movements in this articulation pattern, the wear of the teeth is minimised, thus preventing recurrence of the excessive wear on the incisal edges.

The diagnostic wax-up was copied using a clear vinyl polysiloxane (EXACLEAR, GC) in an unperforated, sectional impression tray (Fig. 6) to create a transparent mould. After setting, the silicone was removed from the tray and holes ending at the incisal edges of the incisors and canines were drilled. On both central incisors, an extra hole was drilled as an escape vent.

Before starting the procedure, the enamel and dentine shade of the teeth were determined with composite buttons (Essentia, GC) on the incisal and cervical third of the tooth, respectively, and with cross-polarised filtered images to remove the influence of the reflection (Fig. 7). This was done because it was planned to restore the incisal edge with a layering approach to give a very realistic appearance.

The old composite restoration on tooth 11 was removed. The teeth were etched and the adhesive was applied and cured in accordance with the manufacturer's instructions. The mould was seated and the composite (G-ænial Universal Injectable, shade A2) was injected (Fig. 8), tooth per tooth, and light-cured through the mould (Fig. 9). Sprue and excess were removed. It was not necessary to separate the teeth from each other, as the proximal surfaces were not involved and the transparent silicone key was fitting precisely, so overflow of the composite was avoided.

Fig. 5: Diagnostic wax-up. a) vestibular view; b) palatal view

Fig. 6: a) A sectional nonperforated tray was filled with a clear vinyl polysiloxane (EXACLEAR). b) Creation of the transparent mould based on the wax-up

Fig. 7: Shade selection (Essentia) with the button technique and cross-polarising filter

Fig. 8: Injection of G-ænial Universal Injectable, shade A2

Fig. 9: Light-curing of the composite through the EXACLEAR mould

Fig. 10: The vestibular incisal part of the central incisors was cut back for the layering technique

For the central incisors, the incisal part was cut back (Fig. 10) to embed various degrees of translucency and opacity in the incisal layer. A more distinct expression of the mamelons in those teeth fits the facial features of this patient and give a natural, young and vivid appearance. The adhesive procedure (etching and bonding) (Fig. 11) was repeated on the cut back part and the composite in the dentine shade that was initially selected (Essentia, shade MD) was used to create the mamelons (Fig. 12). Attention

Fig. 11: The bonding procedure was repeated on the cut back surface

Fig. 12: The mamelons of the central incisors were shaped (Essentia, shade MD) to mimic the natural anatomy of the tooth

Fig. 13: Restored vestibular surface of the central incisors (Essentia, shade LE)

should be payed to obtain the correct thickness; a too thick dentine layer will make the result opaque and less natural, so make sure there is space left to place the enamel layer on top. On the other hand, if this layer is too thin, the effect will not be very visible and the restoration might look somewhat greyish. Thereafter, the selected enamel shade (Essentia, shade LE) was used to complete the vestibular surface (Fig. 13) and the restorations were finished. After rehydration, the teeth showed a good colour integration and surface gloss

Fig. 14: Intraoral view after rehydration

(Fig. 14). The palatal surfaces have an adequate morphology and sufficient concavity, without interference with the anterior closure path (Fig. 15). The

Fig. 15: The palatal surface show sufficient concavity not to interfere with the anterior closing path

extraoral view shows a natural and aesthetic overall appearance (Fig. 16) that satisfied the patient.

Fig. 16: Extraoral view of the final restorations. a) en face; b) oblique view

In conclusion, this technique can be used as a minimally invasive and simplified treatment alternative. In this case, injection moulding was combined with a cut-back technique to obtain a young, lively appearance of the teeth, aesthetically fitting the patient in an optimal way. The reliable reproduction of the wax-up enables us to obtain an end result with a correct occlusion and guidance pattern in a relatively easy way.

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Injecting instead of layering:

How a composite became an all-rounder in my dental practice

Interview with **Dr. med. Dent. Frank-Michael Maier**, Germany

Dr. med. Dent. Frank-Michael Maier *specializes in implantology and implant prosthetics as well as aesthetic dentistry in his dental practice in Tübingen (Germany). With his various research, speaker and author activities, he is highly esteemed internationally among his colleagues. As a member of various working groups and professional associations as well as acting president of the Gnathological Working Group Stuttgart (GAK e.V.), he has been committed to high-quality aesthetic-functional dentistry for many years.*

In this interview, Dr. Maier discusses direct restorative techniques, which for him are an integral part of everyday practice and the basis for minimally invasive and defect-oriented clinical action. In the field of direct restorations, he pays attention to high-quality materials that are universally applicable to various process technologies (e.g. injection moulding, snowplow, tunnel preparation or stamp technique). At the same time, it should be possible to achieve reproducibly good results in an efficient way. In this interview, the dentist explains why he prefers the high-strength universal composite G-ænial® Universal Injectable (GC) and what advantages the thixotropic viscosity of the material has for everyday practice.

Dr. Maier, why do you prefer the composite G-ænial Universal Injectable (GC) as a direct restorative?

The decision is based on various reasons. One of them is universal applicability, although other materials also offer this. However, what immediately impressed me about G-ænial Universal Injectable is its excellent polishability. After many years of working with a composite of another manufacturer, I was pleasantly surprised by the simplicity and quality of the polish at G-ænial Universal Injectable. Without much effort and with just a few steps, the surface shines and more importantly, the gloss in the long term. That was the decisive aspect for me to switch. Soon I got to know and appreciate further advantages of the injectable composite. Especially for use in injection or stamp technology with transparent silicone keys as well as in terms of abrasion stability, the material offers clear advantages. For some time, I was looking for a composite with the appropriate viscosity that also allows me a comfortable handling. I found this in G-ænial Universal Injectable.

What does this mean in concrete terms for everyday practice?

The material composition makes G-ænial Universal Injectable universally applicable. I appreciate the fact that I can work with only a few materials in practice. On the one hand, this simplifies logistics and warehousing. On the other hand, it brings more calm to the treatment process. Thanks to the thixotropic viscosity, G-ænial Universal Injectable can be used efficiently in a wide variety of filling techniques and this significantly simplifies my everyday work. The material remains stable and dimensionally stable during application, but is still flowable during modelling. For example, I use the composite for the semi-direct injection moulding technique (IMT). For this purpose, a silicone key is made of crystal clear silicone (EXACLEAR, GC) based on a wax-up. The composite is then injected via small injection channels and light-cured through the transparent key. This technique works really well with G-ænial Universal Injectable due to the right thixotropic consistency.

For which indications do you predominantly use G-ænial Universal Injectable?

When I think about it, for a lot of different indications. I work with various restoration techniques, e.g. the stamp, snowplow or injection moulding technique and I benefit in all situations from the remarkable flow behaviour of the composite – very stable yet with a little pressure, a thin flow. Another example is the minimally invasive tunnel preparation, in which the material can be "pressed in" well. I also prefer the material for box elevation and as a fissure sealer, applied with a thin nozzle. In addition, I work in implantology with G-ænial Universal Injectable, e.g. I use the material for the individual shaping of the soft tissue or the fixation of screw cylinders in long-term provisionals. Experience has shown that the dense surface results in excellent tissue compatibility. Similarly, I use the material in the ovate-pontic technique for the step-by-step shaping of the emergence profile. This creates the impression of a tooth arising from the socket.

To what extent is the composite suitable for intraoral repairs?

Intraoral repairs of composite as well as glass-ceramic restorations work well, with its success standing or falling with the surface conditioning. In my hands, the intraoral tribochemical roughening of the restoration and silanization have proven itself. Due to the good colour adjustment and polishability, inconspicuous repairs can be made.

And what experiences do you have in terms of the quality of results?

G-ænial Universal Injectable is very aesthetic, although I expect this from all modern composites. Thanks to the 16 shades and 3 translucency levels, almost any situation can be covered in everyday life and work in a highly aesthetic way. I particularly like the shades for imitating the natural enamel. And once again I would like to emphasize the excellent polishability with little effort; the basis for the long-term success of the care. With regard to the edge stability and the abrasion behaviour, I can only report positive things from the recalls.

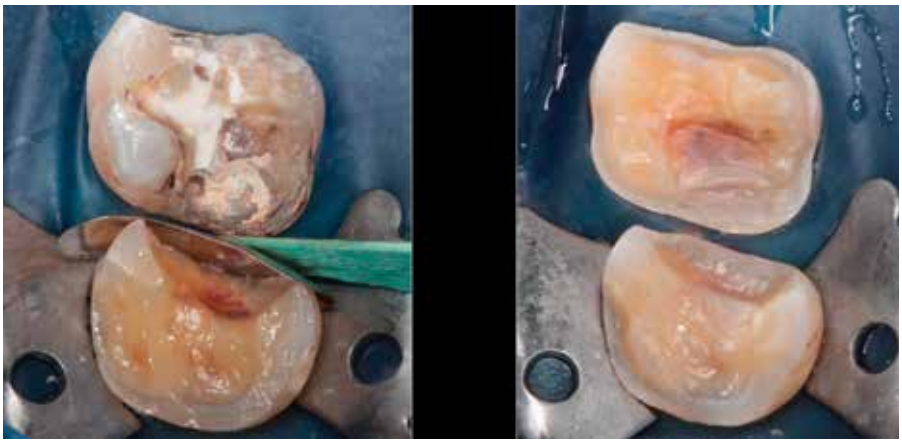
What would you like to instil among your colleagues who are interested in G-ænial Universal Injectable?

Working with the "right" composite is not a primary success criterium, but an important building block for direct restorative restorations. In my opinion, the basis for success is the correct application of adhesive technology, the design and the knowledge of various process technologies. This way, one can act minimally invasively and based on requirements. The advantage of a composite like G-ænial Universal Injectable is the universal use and thus the ideal product for my everyday practice. Due to the injectability of the material, innovative processes as well as proven restorative techniques can be implemented first-class. The thixotropic viscosity of the material

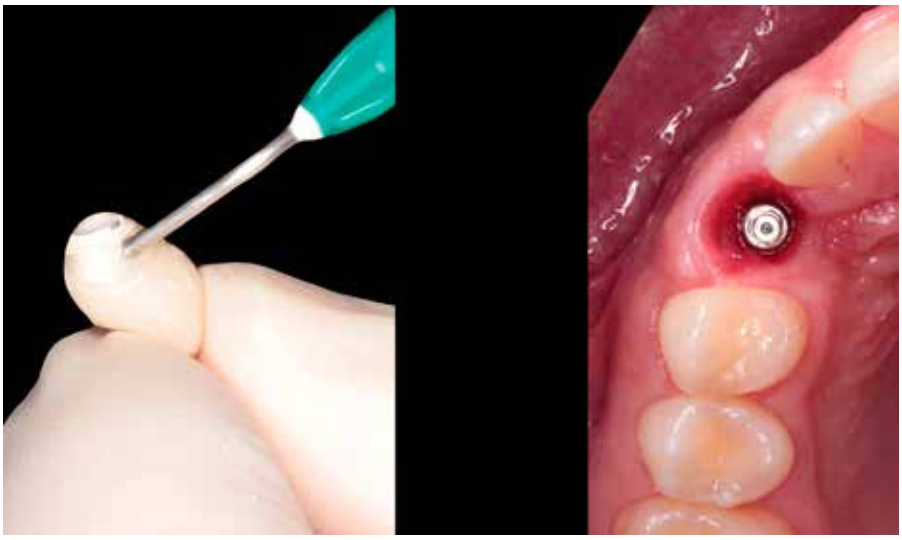
ensures very good handling; the good, efficient polishability is simply fun and the quality of the results is excellent.

Thank you very much for this interview!

Application examples for G-ænial Universal Injectable



Deep Margin Elevation



Shaping the emergence profile in implantology

Injection technology with a crystal clear silicone key (EXACLEAR, GC)

Injectable technique- lateral incisors reshaping after orthodontic treatment

Dr Milos Ljubicic, *prosthodontic resident at Clinic for Prosthodontics, School of Dental Medicine, University of Belgrade, Serbia. Winner of Dental Photography Competition at IDS 2019 in Cologne, and the ESCD dental photography competition, St. Petersburg 2019.*

Dr Marija Zivkovic, *orthodontic specialist, PhD. Associate Teacher at Clinic for Orthodontics, School of Dental Medicine, University of Belgrade, Serbia. Passionate about both scientific and clinical work in orthodontics and general dentistry.*

By **Dr. Milos Ljubicic** and Dr. Marija Zivkovic, Serbia.

The patient, a 17 years old girl, came to the dental office with the aim of improving the aesthetics of her smile. Her main complaint related to prominent mandible, (in front and profile) and small lateral incisors (figures 1a and 1b).

Fig. 1a: Initial situation (Front)

Cephalometric analysis showed decreased value of ANB angle, retrognathic maxilla (decreased SNA angle) and slightly proclined upper and lower incisors. Based on clinical features, model and cephalometric analysis, an orthodontic treatment plan was made. Treatment objectives were to obtain normal overjet and

Fig. 1b: Initial situation (Right and left profile)

overbite and stable static and functional occlusion. The orthodontic treatment included fixed appliances in both upper and lower dental arch, interproximal reduction in frontal region of lower dental arch, followed by class III intermaxillary elastics which aid in lower incisor retraction and molar correction (figure 2a).

Space for normal-sized upper lateral incisors was needed because they were planned to be reshaped after orthodontic treatment.
Orthodontic treatment was finished after 16 months. The patient was satisfied with her new smile, but she wanted to improve even further her upper lateral incisors which she found small. Since she wanted to avoid prosthodontic solutions, she asked for the best non-invasive option with the natural aesthetic result (figure 2b).

Composite veneers are a great way for closing spaces between teeth, since they are perfectly suitable for minor aesthetic interventions in situations with minimal functional stress. Especially if the ideal position of the teeth is set after orthodontic treatment, high levels of aesthetic can be achieved.

To achieve excellent results, an adequate design of the restoration is needed. Impressions were taken, and CDT Vladimir Veselinovic designed the future shape of lateral incisors (figure 3a) and made a wax-up (figure 3b).

Fig. 2a: Brackets on upper and lower teeth

Fig. 2b: Final result after orthodontic treatment

Fig. 3a: Design made by CDT Vladimir Veselinovic

Fig. 3b: Wax-up

Based on the wax-up, a transparent silicone key was made using EXACLEAR (GC), a clear vinyl polysiloxane material.

The impression tray was prepared with silicone stoppers in the posterior region so that the clear silicone thickness would remain the same in every section of the transparent silicone key (figure 4)

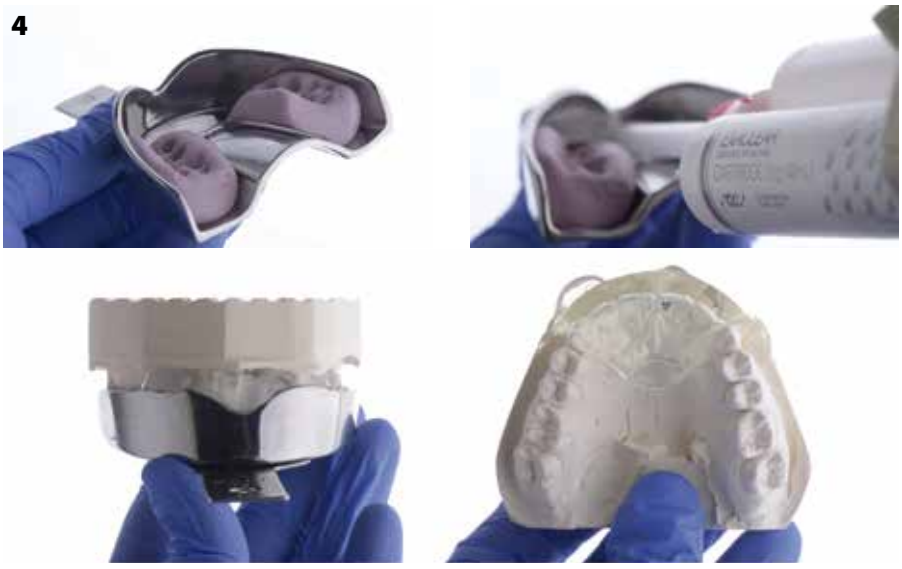


Fig. 4: Confection of the transparent silicone key

Injection channels were created using the syringe tip, ending at the incisal edge so the composite sprue could be easily removed without altering the shape of the restoration (figure 5).

Fig. 5: Injection channels made with the tip of the G-ænial® Universal Injectable syringe (GC)

Another silicone key using a putty material was made based on the wax-up model and cut in 2 parts (buccal and lingual), to check the necessary space for the restorative material (figure 6).

Fig. 6: Silicone index to guide the tooth preparations if necessary

The color of the teeth should be determined at the very beginning of the intervention, after they are cleaned and polished, but before the enamel becomes dehydrated.
The right color was done by placing a small amount of composite on the buccal surface of the teeth to be restored (button technique) and the A1 shade was selected for this patient.
The photos of composite buttons with cross-polarization filters were taken for more accurate color determination (figures 7a and 7b).

Figs 7a and **b:** Shade selection using the "button technique" checked under cross-polarization filters

The silicone key was positioned to check the amount of tooth substrate needed to be removed from tooth 22 to have the same thickness of composite material on both lateral incisors. Tooth 22 was prepared using fine red bur and the putty silicone key was used to check the tooth preparation (figure 8).

Fig. 8: Guidance of the silicone index for the preparations

Retraction cord was placed in subgingival space (figure 9a) and the transparent silicone key was positioned on the teeth to check if everything was positioned, like on the wax-up model (figure 9b).

The results with injection moulding technique are predictable, highly aesthetic and the technique is cost- and time-effective.
The composite material chosen for this intervention was G-ænial Universal Injectable (GC) as it has excellent physical properties and wear resistance.

The teeth were separated and isolated from the adjacent teeth using teflon tape as the use of rubber dam makes more difficult the fitting of the transparent silicone key.

The injections were done one tooth at a time, to avoid the teeth to be bonded to each other.
The teeth were etched with 37% phosphoric acid, rinsed and dried leaving a frosty surface.
The universal adhesive G-Premio BOND (GC) was applied according to manufacturer's instructions (figure 10).

The transparent silicone key was positioned and G-ænial Universal Injectable (GC) was injected and light-cured (figure 11).

After removing the silicone key, a sharp blade was used to remove the excess of composite material (figure 12a) and a glycerin gel was applied (figure 12b).

Fig. 9: The importance to check the fitting of the transparent silicone key

Fig. 10: Etching with 37% phosphoric acid and bonding with G-Premio BOND (GC)

Fig. 11: G-ænial Universal Injectable (GC) being injected through the injection channels

Fig. 12a: Excess removal

Fig. 12b: Glycerin gel to minimize the oxygen inhibation layer

By polymerizing through a glycerin gel for 5 sec. per surface an oxygen-inhibited layer can be avoided.

However, complete polymerization through the silicone key itself should provide the same result.

The same procedure was repeated for the other lateral incisor.

After this minimally invasive restorative treatment was finished, new clear thermoplastic retainers were made to prevent changes in tooth alignment after the orthodontic treatment (figures 13a and 13b).

With injectable technique we achieved highly aesthetic results, improving patient's confidence and self-esteem (figure 14).

Fig. 13a: Aesthetic improvement of the smile

Fig. 13 b: Open mouth showing the color and shape integration of the restorations

Fig. 14: Light behaviour on the composites matching with the natural teeth

Predictable and minimally invasive smile makeovers with the ABC-concept (Align-Bleach-Composite).

By **Dr Sebastian Däröste**, Norway

Dr Sebastian Däröste *graduated from Umeå University (Sweden) in January 2017 and immediately began working in Norway's private sector, always with a modern focus. He sold out of his former practice after shaping it into one of Scandinavia's most profitable single treatment room practices.Nowadays, he's working at Oris Dental Aker Brygge in Oslo. After completing his Postgraduate Diploma in Clear Aligner Therapy he continued with an MSc in Specialist Practice of Clear Aligner Orthodontics. He is one of the world's youngest Invisalign Diamond Providers and is a sought-after speaker for a number of companies, such as Invisalign, Aligner Dental Academy and GC. (@DrDaroste on Instagram)*

More and more patients are looking for mild and gentle solutions for healthier smiles. Thanks to current materials and software, we have the opportunity to recreate better functioning smiles in minimally invasive ways. Tooth tissue removal to create space for various ceramic solutions can therefore, thanks to today's techniques, be avoided in many cases.

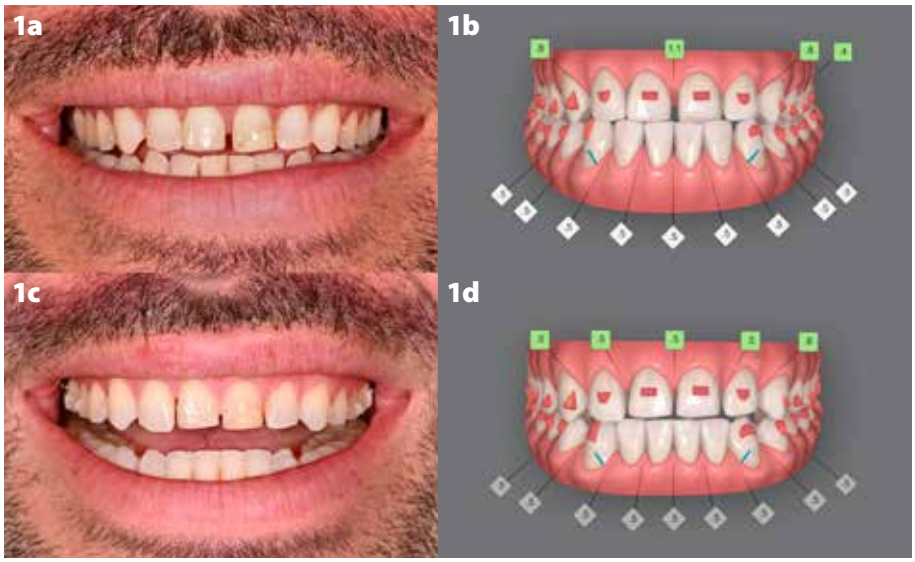


Fig. 1: (a) Initial situation with Angle Class III and consequential tooth wear. **(b)** Starting point for the clear aligner therapy and marked attachments. **(c)** The actual end position after the clear aligner therapy corresponded well with the **(d)** simulated final position.

Case presentation

A man in his late 30s presented with a skeletal Angle Class III and edge-to-edge bite that had contributed to anterior wear (Fig. 1). The patient wished to have longer incisors, to have the obvious composite fillings replaced and the gap closed. The patient declined 'ideal alternatives' such as jaw surgery and/or extractions, but still wanted a solution to the problem. He didn't want ceramics with preparation of the upper and lower incisors either, even though this would have been a significantly faster approach. Rather, the patient preferred a minimally invasive approach.

Orthodontics with clear aligners

A 'camouflage treatment' using aligner therapy was proposed to compensate for the skeletal Class 3 and then build up the worn incisors, which was accepted by the patient. After one year of treatment with 50 clear aligners, without the need for additional aligners, sufficient horizontal overbite was acquired to accommodate composite veneers. Gingival symmetry also improved, with a more proportional distance between the incisors so that overly wide centrals could be avoided (Figs. 1 and 6). During the last stages of the aligner treatment, the teeth were also whitened with a 10% carbamide peroxide gel.

Fig. 2: Attachments (G-ænial Universal Injectable, GC) for the aligner therapy were placed with the attachment template aligner.

Simple and durable attachments with G-ænial Universal Injectable

G-ænial Universal Injectable (GC) in shade JE was used for attachments as it is durable, the shade blends in nicely and it is easily applied with the attachment template.

After the bonding procedure, the resin was applied in the attachment template. The template was then positioned over the teeth and under gentle pressure, the attachments were light-cured onto the teeth (Fig. 2). Note that G-ænial Universal Injectable is also convenient for the attachment of a fixed retainer after orthodontic treatment.

Composite veneers after aligner treatment

After removal of the old composites, composite veneers were made using the injection moulding technique (Fig. 3). First, a layer of G-ænial Universal Injectable in a dentine shade (AO2) was placed freehand to avoid an obvious transition line between the old fracture edge and the tooth (Fig. 4). Two moulds from firm transparent silicone (EXACLEAR, GC) were used. Next, G-ænial Universal Injectable (shade B1) was injected into mould number one after every second tooth was isolated with Teflon tape. Excess was removed and then the same procedure was carried out with mould number two (Fig. 5). Before and after pictures are immediately after completion. The gums will gradually improve over the next few months (Fig. 6).

Fig. 3: Mould number one and mould number two made from EXACLEAR (GC). In the first guide, half of the teeth (alternated) are built up, while in the second guide, all teeth are built up. Working with two guides results in less excess to be removed, which results in a more precise outcome and considerably reduces the treatment time.

Fig. 4: After removal of old composite, the dentin layer (G-ænial Universal Injectable) was placed freehand using the finger technique.

Fig. 5: Injection of G-ænial Universal Injectable (Shade B1) in the EXACLEAR mould (picture: guide number two).

Fig. 6: Before (top) and after (bottom) pictures after the aligner treatment and 6 composite veneers with the injection moulding technique.

Conclusion

With the combination of aligners, bleaching and composite, all elements are there to create the perfect smile: the correct tooth position, tooth shade and shape can be created in a sensible, minimally invasive way. Simple as ABC!

Injection moulding technique with injectable composites: quick fix or long-lasting solution?

By **Prof. Marleen Peumans** (Belgium),
Dr. David Geštakovski (Croatia),
Dr. Jacopo Mattiussi (Italy) and
Dr. Kostas Karagiannopoulos (United Kingdom)

Prof. Marleen Peumans *(Belgium) graduated at the KUL (University of Leuven, Belgium) and is specialised in adhesive dentistry. Currently, she is Head of the Department of Restorative Dentistry of the same university*

Dr. David Geštakovski (*Croatia) graduated at University of Zagreb. After graduation he moved on short period of time to work in Dublin (Ireland). Nowadays he works in private dental office in Zagreb. He is member of Croatian Academy of Aesthetic Dental Medicine and European Society of Cosmetic Dentistry.*

Dr. Jacopo Mattiussi *(Italy) graduated in Dentistry and Dental Prosthetics with honours at the University of Genoa. Currently, he is working in several dental practices in the conservative, prosthetic and endodontic field with a particular passion and attention for aesthetic and adhesive dentistry.*

Dr. Kostas Karagiannopoulos *(United Kingdom) graduated at the Queen Mary University, whereafter he specialized in prosthodontics in King's College (London, UK). Passionate about education and comprehensive dentistry, he is currently offering patient care in 2 specialist clinics near London and teaching training specialists at King's College.*

The injection moulding technique with injectable composites, which became known to dentists worldwide due to the work of Dr Douglas Terry,[1-3] has become increasingly popular in the latest years. It is a relatively simple procedure that makes it possible to obtain a predicable end result, even in complex situations, because the morphology can be determined in advance. It is in part because of the development of suitable, high quality materials, such as G-ænial Universal Injectable and EXACLEAR, that injection moulding has a reliable procedure. G-ænial Universal Injectable has the ideal consistency and mechanical properties and thus it is widely used for this technique. Combined with the highly transparent EXACLEAR silicone, the technique has become approachable and easy to conduct. In the following overview, it is shown how the restorations that were made with this technique can stand the test of time.

Case 1: Restored occlusion after severe general wear by Prof. Marleen Peumans, Belgium

Because of its high wear resistance, G-ænial Universal Injectable can also be used to restore occlusal surfaces. This is particularly useful in case of abrasion/erosions in the molar area and has the advantage that it can be used in a minimally invasive way. In these cases, careful planning is imperative to restore the function in a correct manner. Injection moulding is a valuable method for a correct restoration of a physiologic occlusion with the aid of digital modelling techniques. Two models were printed: one with every second tooth restored and another one with all teeth restored. Based on those, two transparent silicon indices were made (Exaclear, GC). Working with two silicone indices has the advantage that the intraoral seating is more stable, there is greater control of excess material on adjacent teeth and a better emergence profile can be created.

Four models were made in total (two per jaw). Three years after treatment, the surfaces still look smooth and shiny, without obvious occlusal wear facets.

Fig. 1A: Worn occlusal surfaces and maxillary diastema before treatment. The colour of the teeth, discloses the loss of surface enamel, with the colour of the dentine clearly showing through.

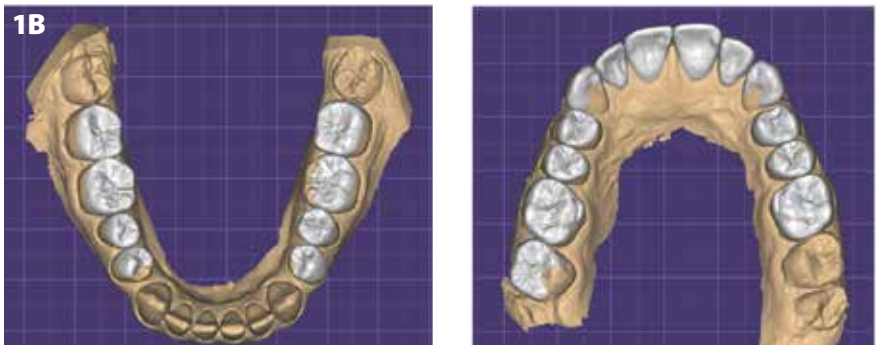


Fig. 1B: Computer-aided design of the restored occlusion. The diastemata between the maxillary incisors were restored as well. (Digital design by Dr. Pierre Dimitrov, Bulgaria)

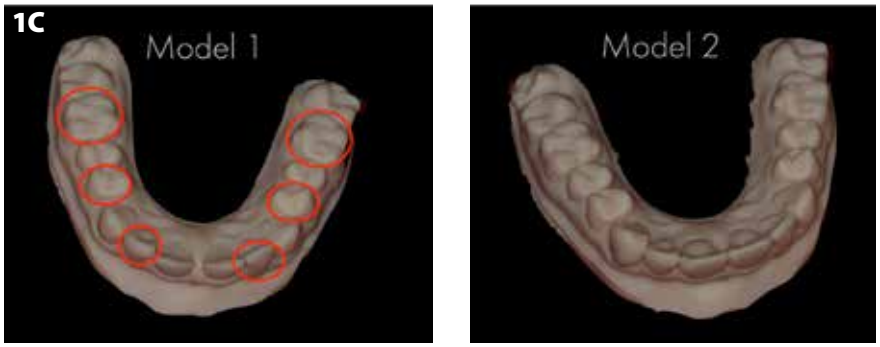


Fig. 1C: The two 3D-printed models of the maxilla; in Model 1, every other tooth was restored, while in Model 2, all teeth were restored.

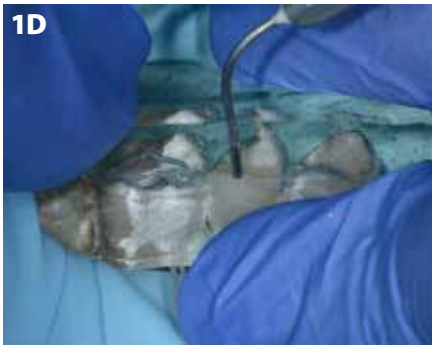


Fig. 1D: Injection moulding with G-ænial Universal Injectable in a transparent mould.

Fig. 1E: Restored dentition after treatment.

Fig. 1F: Close-up of the fourth quadrant.
Top: before treatment;
Upper middle: at baseline (after restoration);
Lower middle: one year after treatment;
Bottom: three years after treatment.

Case 2: Cost-effective aesthetic rehabilitation by Dr. David Geštakovski, Croatia

In the presented case, 6 composite veneers were made on the upper incisors and canines with the injectable moulding technique.
After facial analysis, teeth were scanned and a digital 'wax up' was made.

Based on the wax up, an intraoral mock-up was done to check guidance, functional parameters, aesthetics, and phonics. To get long lasting results, function needs to be planned in a correct way. Therefore, canines were included to obtain canine guidance in order to avoid potentially harmful contacts and forces on incisors, which may cause chipping of the restorations. Because of the low lip line the patient's gingiva was not visible in the forced smile so the asymmetry in the soft tissue around the central incisors was left as before. In this case, the silicone indices (EXACLEAR) were again based on two different 3D-printed models, for the same reasons as mentioned in Case 1 (vide supra).
Teeth were cleaned and etched, retraction cords were packed in the sulci to prevent crevicular fluid from flowing in field of work and to avoid subgingival flow of the injectable composite. Adjacent teeth were isolated with Teflon tape and after the adhesive protocol (G-Premio BOND, GC), G-aenial Universal Injectable (GC) was injected and polymerized directly onto the teeth. A1 shade was used for the incisors, while the canines were done with A2. For finishing and polishing, a scalpel n° 12, Epitex strips (GC), a fine diamond polishing bur and silicone spirals were used.

Two years later, the restorations maintained high aesthetic quality, without chipping or marginal discolorations.
The beauty of this technique is its predictability and possibility to achieve great symmetry and marvellous primary, secondary, and tertiary morphology.

Fig. 2A: Initial situation.

Fig. 2B: Checking the size of the injection holes in the silicon index (EXACLEAR, GC) on the first 3D-printed model.

Fig. 2C: Result directly after treatment, showing nice shape and morphology. The gingival line was not modified since it was not visible during smiling.

Fig. 2D: Result after two years. The shape of the restorations was maintained, without chipping or marginal staining.

Case 3: Interceptive restorative treatment of a full mandibular arch by Dr. Jacopo Mattiussi, Italy

In this case, G-ænial Universal Injectable was used to offer the patient a long-term temporary solution that did not hinder a more complex full-mouth rehabilitation in the future because the economic situation of the patient did not allow such treatment at the moment.

Fig. 3A: Initial situation. The upper jaw was restored three years ago by means of a voluminous zirconia full-arch restoration of which the patient was not very satified. The lower jaw was highly chromatic in comparison, with a considerable amount of tartar, extensive destruction of the hard tissues and periodontal attachment loss.

In contrast to the previous cases, no CAD/CAM technique was used to make the design, but a traditional wax-up and bite registration were done. The vertical dimension was slightly increased and occlusal planes and curves were regularised as much as the pre-existing situation allowed it. Here, only one clear silicone key was used to restore the entire lower arch was restored in a single session. The result impresses in terms of aesthetics and the patient was very satisfied. It was ensured that the patient could clean all interdental spaces and at follow-up, healthy gingival tissues could be seen.

Fig. 3B: Impression taking and facebow registration. The wax-up was made with the aim of increasing the DVO just enough to regularize the occlusal planes and curves, with obvious limitations dictated by the morphology of the upper maxillary rehabilitation.

Fig. 3C: The lower are was restored per sextant. Old restorations were removed, cavity edges rounded and their surfaces sandblasted. The enamel was selectively etched before application of G-Premio BOND (GC).

Fig. 3D: Images taken two and a half months after treatment. Harmonized aesthetics, a normalised vertical dimension and excellent health of the soft tissues are evident from the observation.

Case 4: Treatment of localised wear of anterior teeth by Dr. Kostas Karagiannopoulos, United Kingdom

A 45-year-old man presented complaining of the appearance of his front teeth. Severe localized tooth surface loss of multifactorial origin led to short clinical crowns. Worn teeth in occlusion due to dentoalveolar compensation have the restorative disadvantage of lack of interocclusal space. It was decided to proceed with additive composite restorations to restore the affected teeth using the Dahl concept: this is a method of treating the localised wear of anterior teeth, without having to treat the posterior teeth. The latter are discluded and allowed to re-establish itself over time. All primary disease was controlled prior to the restorative phase, including the intrinsic acid erosion.

The alternate tooth technique was used to carry out the injection moulding technique. Once proximal and gingival excess was removed on all 6 restorations there was minimal finishing as the anatomy was wax-up driven and not freehand. The final result exhibited good surface texture and lustre whilst anterior guidance was maintained.

Fig. 4A: Pre-operative photographs.

At a follow-up appointment after 20 months, no chips, fractures or debondings were observed. The patient is a heavy smoker and sees the hygienist regularly. Occlusal contacts were fully re-established on the posterior teeth after completion of the Dahl movements and the patient is now wearing an occlusal appliance at nights. Of note is the high gloss retention of the six direct composite restorations. No further polishing was done on the facial surfaces during that 20 month period.

Fig. 4B: Diagnostic wax-up on printed models

Fig. 4C: Immediate treatment result. The ability to replicate anatomic details and microtexture on the facial surface with the injection moulding technique combined with a fairly rigid stent exceeds that of all other direct composite techniques. Note the slight disclusion in the posterior area.

Fig. 4D: At the 20-month follow-up, the occlusion was fully re-established. The high gloss retention of the six direct composite restorations was noteworthy, eliminating the need for repolishing.

Conclusion

Injection moulding has a wide range of indications, from anterior to posterior, from interceptive to final restorations, for aesthetic as well as functional rehabilitations, without excessive requirements in terms of clinical skills. The excellent strength and gloss retention of G-ænial Universal Injectable contribute to a maximum longevity for this type of treatment.

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Injection moulding is a contemporary technique in dentistry, which enables to reproduce a detailed morphology in a quick way. For this technique, a transparent matrix is used (**EXACLEAR**), through which the composite can be cured without leaving an oxygen inhibition layer. With the minimally invasive cavity preparation, the resultant space needs to be filled with a composite with a more flowable consistency. World-leading technologies have enabled GC to define a new benchmark in composite: **G-ænial Universal Injectable**, an injectable composite offering exceptional strength, polishability and aesthetics, also ideally suited for this technique. It's a new paradigm in thinking that a composite with a more flowable consistency is actually your strongest option!

Initial situation, front view

A transparent silicone matrix (EXACLEAR) is created by making an impression of the wax-up

Injection holes, large enough to fit the needle tip of the syringe are drilled, ending on the incisal edge

The teeth are slightly roughened with a bur

Etching of the enamel provides additional micromechanical adhesion

A universal bonding agent (G-Premio BOND) is applied in accordance with the manufacturer's instructions

The bonding agent is light-cured

The EXACLEAR matrix is seated

After injection, the restoration can be finished and polished

The same procedure is followed for the other teeth

The surface morphology of the wax-up is copied in detail to the final restorations

Final result, front view

Courtesy of Dr. Z Baktai, Hungary

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