A Ceramic solution with overlapping systems. Part 1

Systematic Bioesthetic Dental Restorations

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When making dental restorations there is only one role model to take seriously: the corresponding natural tooth. Covering a metal frame with porcelain and converting it into a bioesthetic restoration requires building a crown exactly as nature has 'built' a natural tooth.
Fifteen years ago, Michael Brüsch MDT, and Ralf Dahl MDT developed a simple and systematic concept, which can be applied to all systems. Existing ceramic systems, tried and true in the classical sense, have been only marginally successful at producing bioesthetic restorations. The demands of today's enlightened dentists and patients have spurred the authors to seek new ceramic systems. The resulting ceramic system is not a snapshot idea, but a philosophy that has grown over the past four years through cooperation with GC Europe/Klema.

Indication: Bioesthetics, Chroma, Fluorescence, Morphology, Transparent Dentin

The revised layering scheme described in the following article has only one purpose: to create the most perfect copy of a natural tooth. Instead of producing another extravagant build-up technique, it is based on precisely observing natural teeth, to analyze and create the most exact copy possible (1). This is accomplished through simple and logical steps based on a natural tooth model resulting in a bioesthetic restoration.

The Natural Way

In the past, we all learned to build porcelain in the following way: apply opaque, build dentin, layer enamel and add translucent material. Unfortunately this procedure has little correlation with a natural tooth. Of course, there is transparency on the surface of a natural tooth, but transparency is found primarily inside all natural teeth -in the transparent dentin. Transparent dentin is a 0.2 -0.3 mm layer found in every tooth.
In anterior teeth, abrasion and wear over time causes this transparent layer covering the dentin to appear at the incisal edge. This changes the transparency of natural teeth considerably depending upon the angle of light. The teeth appear at times lighter, grayer, darker or even deeper in chroma. The amount of light reflecting into or through the transparent dentin also changes the perception of depth.
It is interesting that this internal transparent layer comes to the surface at the junction of the root and cervical margin, completely covering the root and influencing the value of the gingiva. It therefore makes no sense to use opaque margin materials in this area where nature shows us otherwise. In a natural tooth, a unique arc of light can be seen in this area. GC Initial's highly chromatic and fluorescent

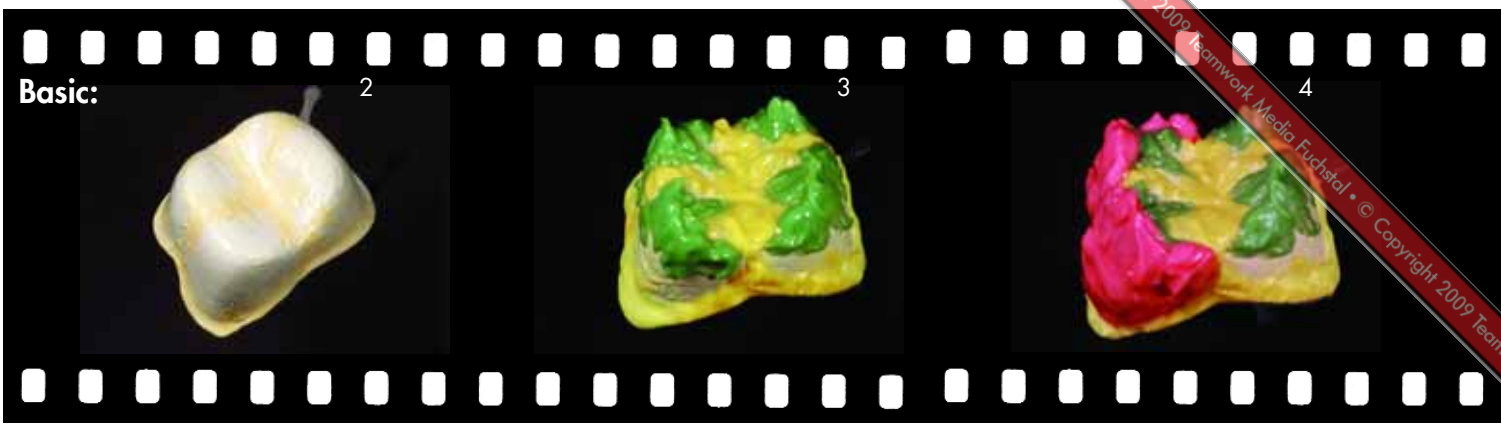
Fig. 1
Our Aim:
Bioesthetic Dental Restorations

Inside powders imitate the primary dentin and fluorescence, which lie imbedded within the teeth. Layering dentin material over the Inside material, achieves a perfect balance of chroma and value. Pairing fluorescent crystal clear transparency with real opalescent enamel makes it possible to copy the impression and effect of natural tooth structure.

Simple, universal and individual layering

The GC Initial System includes procedures that can be universally applied to any dental restoration. They can be transferred to any framework, regardless of the pre-treatment. Different frame materials will not influence color and light dynamics so that one technique can be used on any framework including zirconium, titanium, non precious metal, precious metal or refractory. This means that the ceramist begins "learning from the first crown", since there is only one procedure.

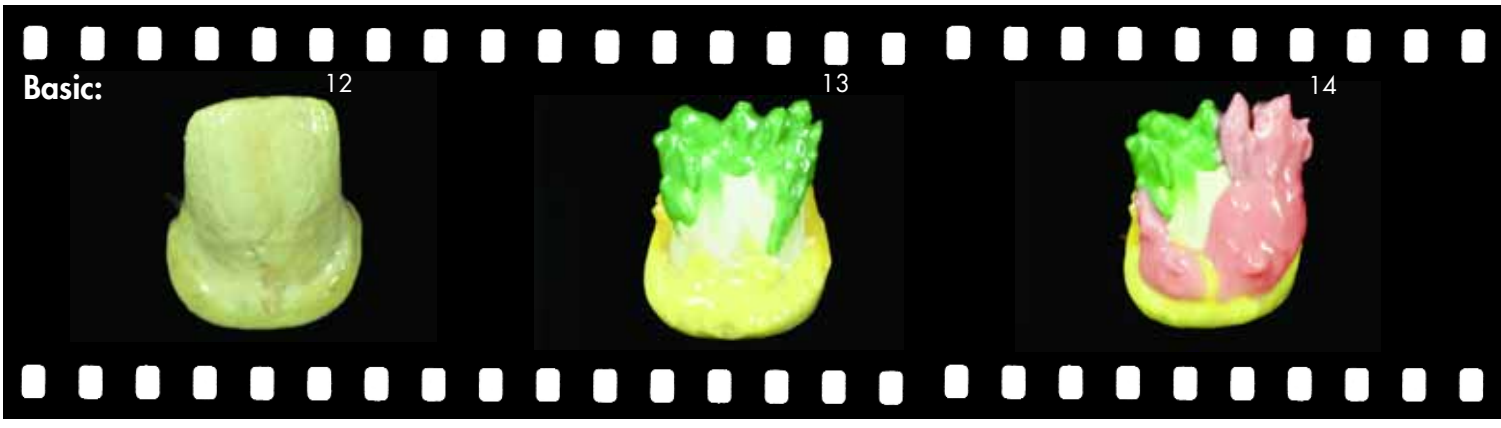
To begin, there are two basic layering methods: one for posteriors and one for anteriors. These simple build-ups contrast sharply with the so-called "classic layering technique" (figs. 2-21). The bioesthetic layering method is determined when the dentist chooses the shade. In comparison, the detailed advanced layering method is oriented towards perfecting a copy of the light dynamics in a natural tooth. Even correctly taking a patient's shade is a big challenge. Making allowances for the way color plays in natural teeth under different light situations is unmistakably difficult and almost impossible with conventional ceramic materials. Even highly talented technicians are dependent upon the ceramic materials to produce these dynamic light effects. By contrast, when these materials are layered analogously to the structure of natural teeth they automatically produce a complete and logical layering process (figs. 22-35). The natural chroma and fluorescence inside teeth combined with the surface opalescence seen within the context of natural shape and color variations can be transferred easily. Teeth are complex 3D-systems. It is necessary to look at the biological structural build-up again and again (figs. 37 -43).



Figs. 2 and 12 Individually stained opaque on all metal frames. Its effect comes from the Inside and creates a natural color impression.

Figs. 3 and 13.
Inside powders on the cervical and occlusal (yellow) to increase chroma and opacious dentin (green) to eliminate light refraction on the edge.

Figs. 4 and 14
Build-up



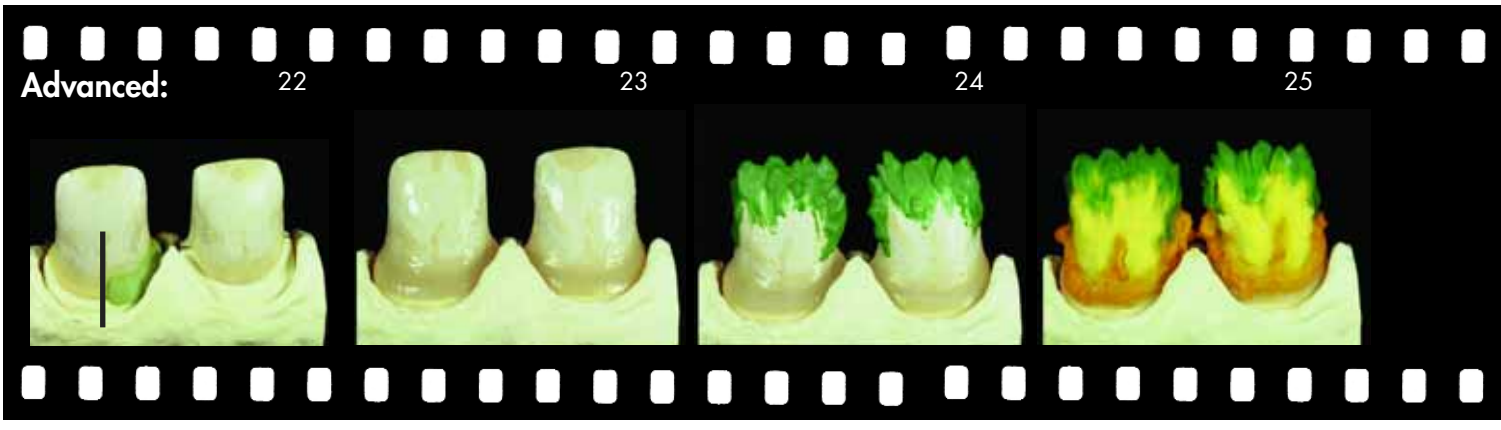


Fig. 22 Whitish opaque shoulder porcelain covering the transition area plus a layer of translucent margin material (green) before…

Fig. 23… and after firing.

Fig. 24 Covering the edge with highly fluorescent dentin material.

Fig. 25 A thin layer of Inside material completely covering the opaque, including the cervical area. (In this case two different Inside shades were used.)

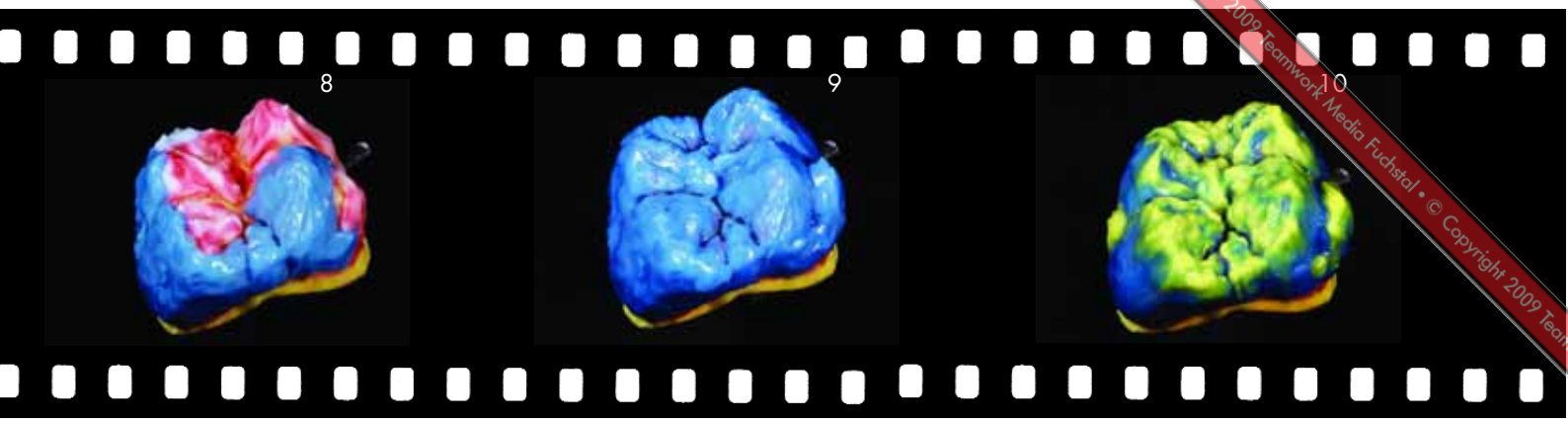
Figs. 5 and 15
...and the final dentin build-up

Figs.6 and 16
Step by step the whole dentin surface is...

Figs. 7 and 17
covered with CLF powder (clear fluorescent) to imitate the transparent dentin.

Figs. 26 and 27 Thin dentin layer and Incisal table to determine the incisal and proximal edges.

Fig. 28 Dentin cutbacks in the incisal third down to the highly fluorescent dentin (FD-91, FD-92 or FD-93)



Figs. 8 and 18 Cover layer and…

Figs. 9 and 19
…final build-up of the morphology with opalescent powders.

Fig. 10
Surface characterization with whitish opaque enamel (cusp ridges, edges and grooves.

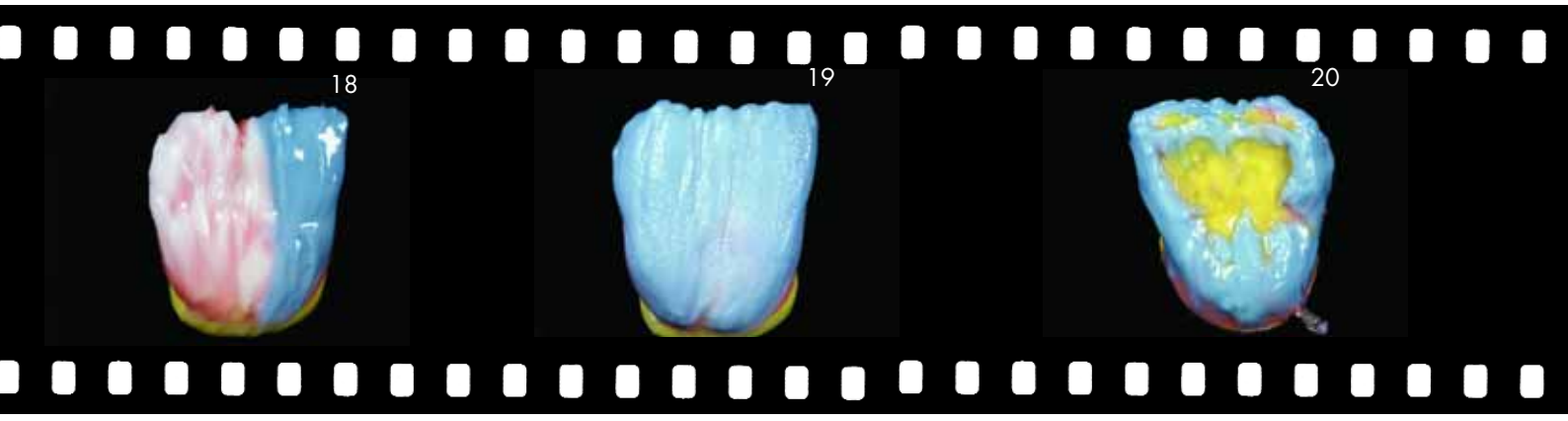


Fig. 20
The opaque on the palatal is covered with the corresponding Inside shade and completed with white enamel.

Fig. 29 Layering over the incisal table (in this case with FD-91)

Fig. 30 Colored mamelon structure with Inside material

Fig. 31 The internal build-up is completely covered with a layer of CLF material.

Fig. 11
Final result of the basic layering method.

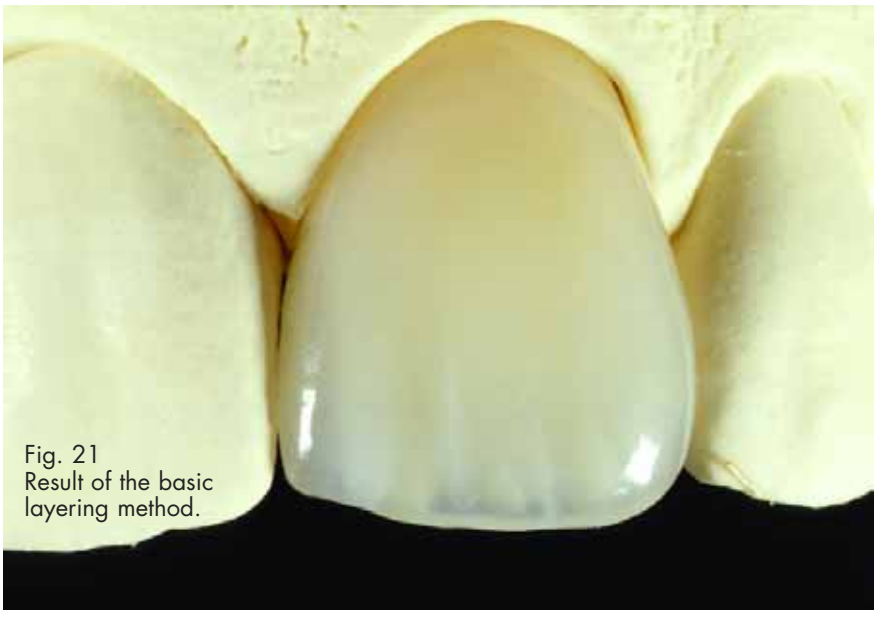


Fig. 21
Result of the basic layering method.

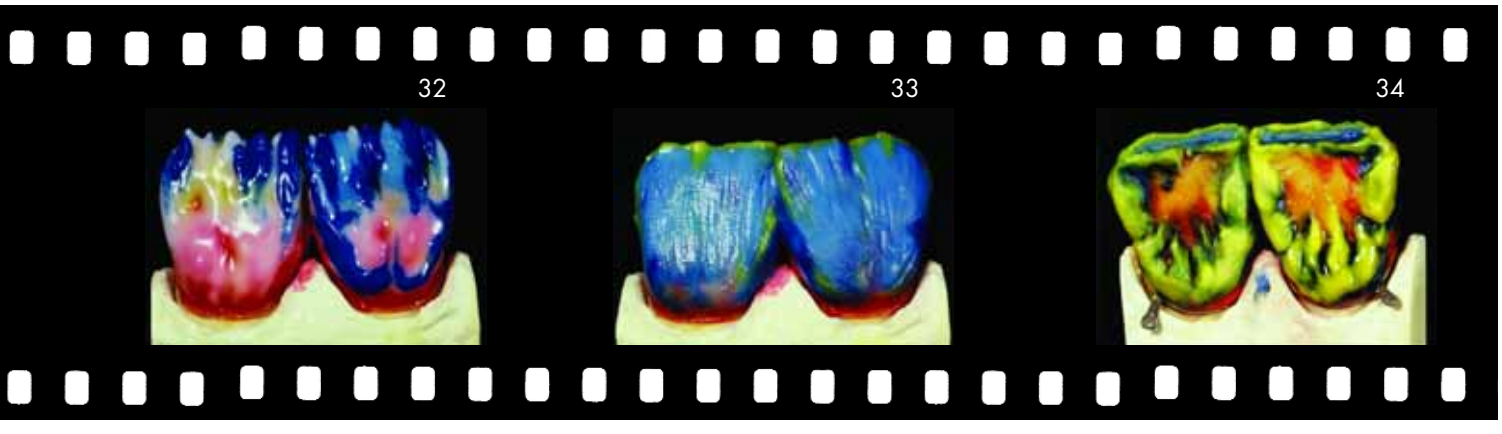


Fig. 32 Alternate layering of enamels with various opalescent, translucent and transparent enamels.

Fig. 33 Final shape build-up with opalescent materials.

Fig. 34 The palatal surface is covered with EO-15 imitating the" bony" effect of functional edges.

An almost perfect deception

Anterior teeth pose the greatest esthetic challenge. The incisal build up is very sensitive, since all optical light phenomena join in this small space. In particular the layering over the incisal table is very critical (Fig. 27) because the most light is transmitted here. This area also highlights the greatest difference between feldspathic and synthetic ceramics. A totally different optical appearance can result. The biggest problem occurs when dissimilar frame materials are used side by side or in proximity to one another. The differences can be neutralized with the high fluorescent dentins (FD 91-93) and the Inside powders (see figs. 24+25).

The light flooded incisal third is also covered with the white fluorescent FD-91 (see fig. 29). As in painting, the base for the mamelon structure is neutralized. Since incoming light always reflects off this "blocking layer" in the same light wave spectrum, the colors applied on top always appear the same. These optical "illusions", allow different types of restorations to be used successfully next to each other. Special attention should be paid when applying fluorescent transparent material (CLF), because this layer has the most influence on the appearance of color and depth in a ceramic restoration. Transparent dentin (CLF) comes to the surface more through abrasion in a natural incisal edge. Because of this, light influence in a tooth is clearly increased (raised) and can produce, depending on the light situation, a radical change in the color result. The spectrum ranges from gray transparent to amber to a compact, almost opaque effect. The CLF layer makes it possible to correct the transparency in a crown after firing without changing the intricate morphology built up. If, when the crown is tried in, there is not enough transparent, the incisal edge is simply reduced more on the palatal side (figs. 35-37).

Figs. 35 and 36
Advanced layering result

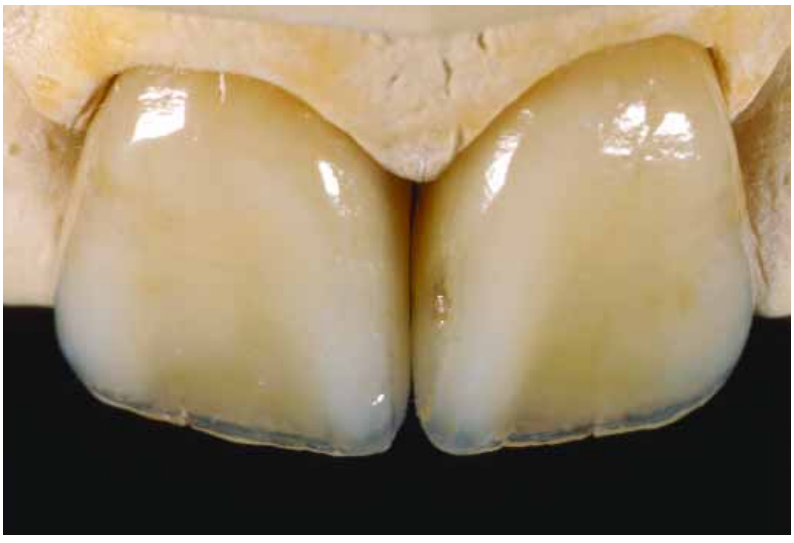


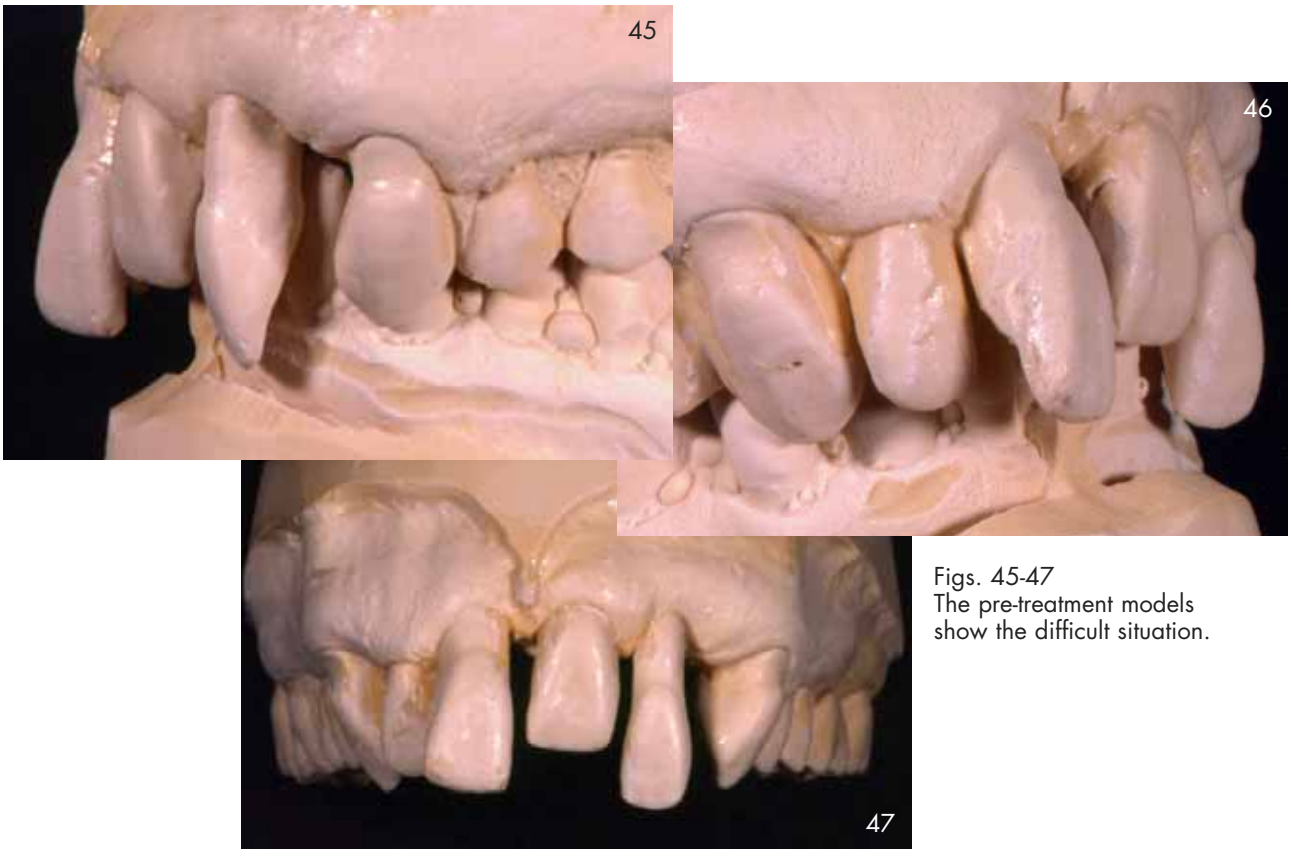
Fig. 37
A critical zone, the incisal zone

Figs. 38 to 41
The variety and color dynamics of natural teeth are always a challenge. They exhibit highly fluorescent chromatic internal areas paired with opalescent enamel parts.

Figs. 42 and 43
Sectioned views can help identify the natural tooth build-up.

At the same time more light influence in the CLF layer provides a definite increase in transparency within the restoration. If there is too much transparency, the CLF layer can be covered with stain along the incisal edge until the desired effect is achieved and then glazed. In the mouth, too much transparency often appears as an ugly, unnatural gray, flat effect. Opalescent enamels compensate for this impression very well (figs. 38-43). When compared to conventional enamels, the difference is enormous. The latter correlates well with the Vita Lumin shade guide, but not with the dynamics of natural teeth. Opalescent effect on the surface, fluorescence coming from the inside creates a highly natural appearance setting it apart from ready-made shade guides. The light, very natural brightness of the crowns, due to the opal materials, differs from the grayish Vita shades. Unfortunately most dental technicians usually orient their porcelain build-up to the Vita shade guide.

Fig. 44
The before situation of the first patient case in situ.



Figs. 45-47
The pre-treatment models show the difficult situation.

First Patient Case

This complicated patient case should be solved with minimally invasive, esthetic treatment (figs. 44-47). During pre-treatment it was obvious that tooth 22 had to be extracted. The plan called for refractory veneers on 11,12 and 13. Bioesthetic layering works very well here since there is no framework interrup-

Fig. 48
The crowns on 11 to 13 were prepped for a full ceramic restoration. The plan called for a reinforced metal ceramic bridge to span 21 to 23.

Fig. 49
The full ceramic partial crowns were built on the refractory dies. The bridge had to be reinforced with low framework connectors; the plan was to place the tooth with gaps because of its extreme width.

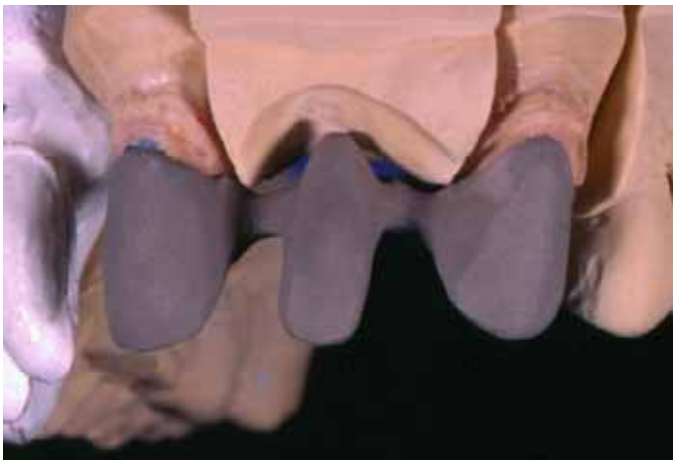


Fig. 50 The bridge in detail. The pontics had already been pre-treated with long-term provisionals and given effects.

Fig. 51
This picture clearly shows that the two materials (refractory dies and metal ceramic bridge) received exactly the same treatment: Inside materials and highly fluorescent dentin were used for the first supporting bake.

tion. To restore the 2nd quadrant, porcelain fused to metal was indicated (fig. 48). The gap presented a problem because it was too large to be properly filled. During pre-treatment the gingiva for 22 was prepared with the long-term provisional. During this time the large gap between 21 and 23 was very problematic. To make the visible tooth 22 appear more separated it was decided to make the connections relatively narrow and very close to the margins. Unfortunately, this type of connection made it impossible to use a full ceramic restoration with zirconium oxide (fig. +50)this usually denotes multiple fig. but only one is listed here; there isn't a caption listed, either). With the porcelain facings we proceeded step-by-step using the advanced procedure. The bridge and the single units were built at the same time using the same process. For the supporting firings highly fluorescent dentin and Inside materials were used on the refractory dies as well as on the metal frame. The light reflecting edges of the dies and the crowns were covered with high fluorescing materials, on the proximal areas and body Inside material was used. In this way the respective bases or frameworks are properly neutralized by the strongly reflective fluorescing materials allowing the next layers of body shade and enamels to be consistent across the restorations. Gingival powders were necessary in this situation to hide the very atrophied ridge and the bridge connections (fig. 51).

Fig. 52
First firing, complete ceramic build-up

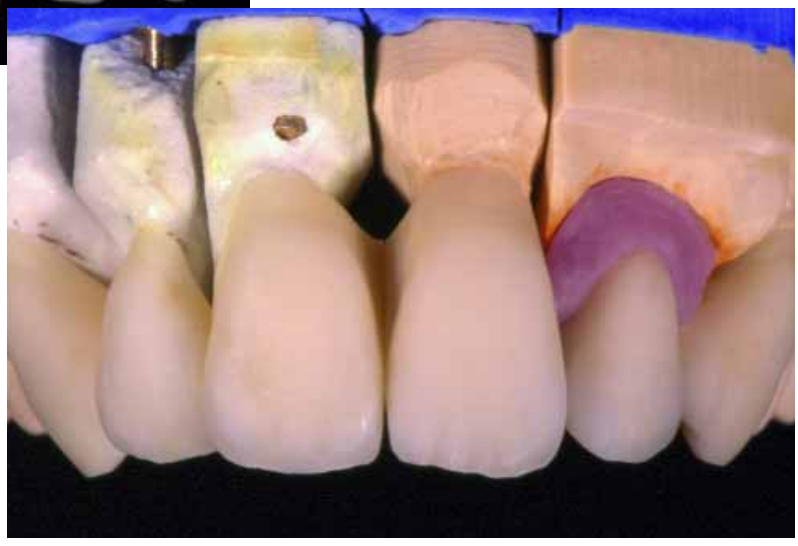


Fig. 53
The restoration after the first correction bake...

Fig. 54
... and after the glaze firing.

Fig. 55
Checking the proximal contacts on the solid model. The pronounced Shadow-ridge situation is shown clearly. There is no visual difference to be seen between the full ceramic and the metal ceramic restorations.

The next step shows the first complete build-up of the restoration (fig. 52). In this system shoulder porcelain and the appropriate amount of Inside material can be fired together in the first bake. This saves an enormous amount of time. All the following layering parameters are according to the advanced layering method (figs. 20-32). The correction bake (fig. 53) is followed by the glaze bake (fig. 54). Since full ceramic restorations are made to fit passively and cemented adhesively, it is necessary to check the proximal contacts on a solid model (fig. 55). At this point it is clear that the color adjustment between the full ceramic and the metal ceramic restorations is perfect. After the restorations were

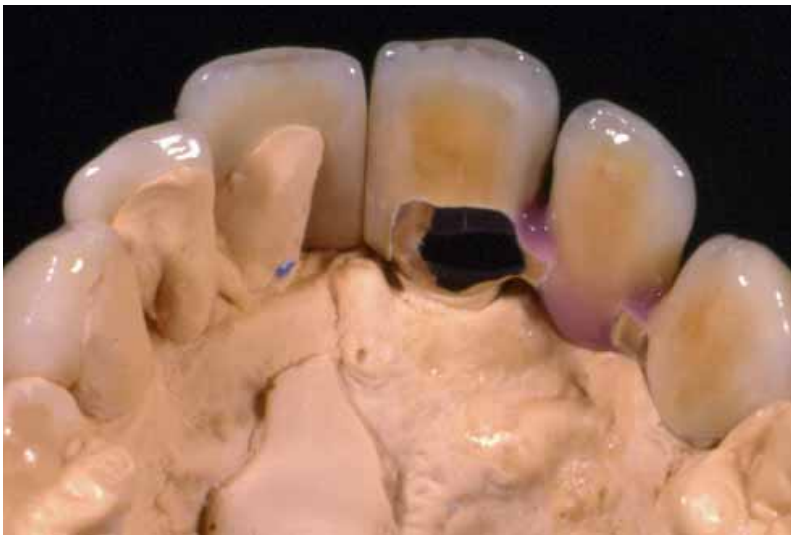


Fig. 56
View from the lingual, note the minimally invasive preparation.

Fig. 57 and 58
Lateral view of the restoration on the model.

Fig. 59 and 60
The restoration in harmony with its oral environment.

completed it was noted that the interproximal areas (especially between the central incisors) should have been a little lighter. Because of the shadow effect there was a small dark triangle. In this case applying a lighter Inside shade would have been more pleasing. From the lingual it is easy to see the problems encountered with this restoration: the low framework connectors reinforced on the palatal side, 22 placed with gaps and the required overlap in the first quadrant due to very tight spacing between preps. The extreme shadow ridges between 11 and 21 were neutralized using fluorescent and Inside material. Later the interproximal space between 11 and 21 was opened slightly to make a more harmonious appearance. This is certainly not an ideal restoration, but considering the pre-treatment situation, and the resulting difficulties, it is a pleasing result. The patient was more than satisfied with her new appearance.

Fig. 61
The situation before…

Fig. 62
…and after treatment. Considering the pre-treatment situation, a very pleasant result. Later, a small gap between 11 and 21 was opened to improve the esthetic result

Sectioned views of teeth as a model

Worldwide the internal tooth structure is identical. Only the shape, the internal shading and the always-present anomalies make them infinitely individual. With guidelines for esthetics, morphology and gnathology, we have for many decades attempted to come closer to our model of a natural tooth

Choosing the shade is always a very individual problem. During the past 16 years, we have tried to develop some standardization in this area. After evaluating over 2500 tooth shades before and after preparation it can be said, that there is a correlation between internal and external shade effects. These results are purely empirical and not scientifically confirmed. Consistent, practical success has led us to recommend the following working method. The concept for the (GC Initial) Inside system was created with this basic philosophy:

A natural color effect can only result from the Inside out.

The main purpose of the Inside powders is to strengthen the chroma from the depths, allowing for approximately.1 mm of transparent or Opal enamel analogous to the structure of a natural tooth. The dentin body can then be layered very thinly over a metal frame. In full ceramics, these materials produce a true-to-nature build up (Fig. 63-64). Sectioned views illustrate exactly where the layers must be placed (fig. 65-66). In a full ceramic inlay, the preparation depth provides the reference point for the powders for each layer. The selection decreases from bottom to top producing first-rate results. Simply stated: Observe exactly.

The structure of a tooth is ingenious (and especially) ingeniously simple (figs. 67-72). In veneer restorations (figs. 73-79) the interaction between the material and a systematic build-up is clear. Extraordinarily different layer thicknesses are visually bridged and converted to an esthetic success

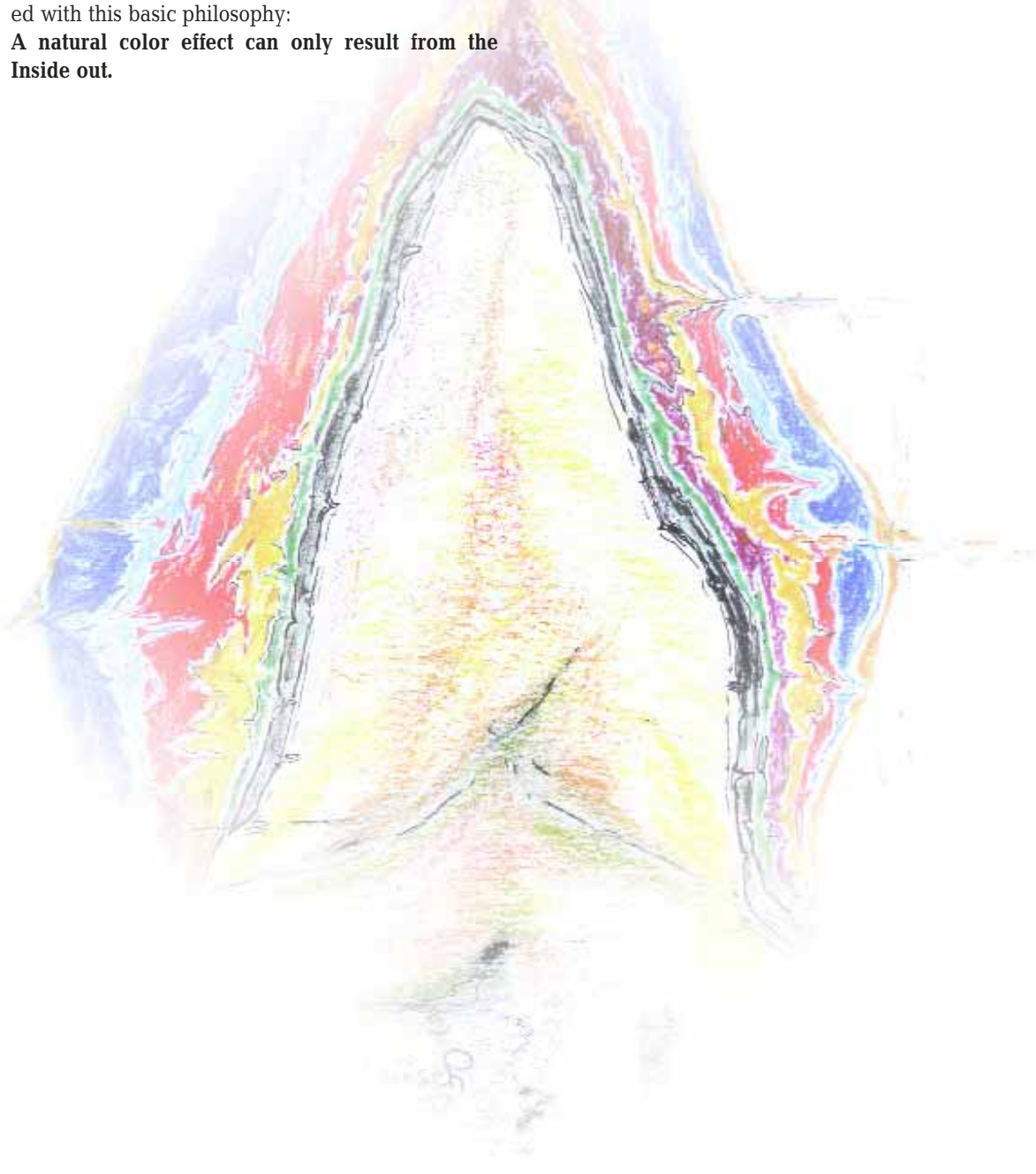
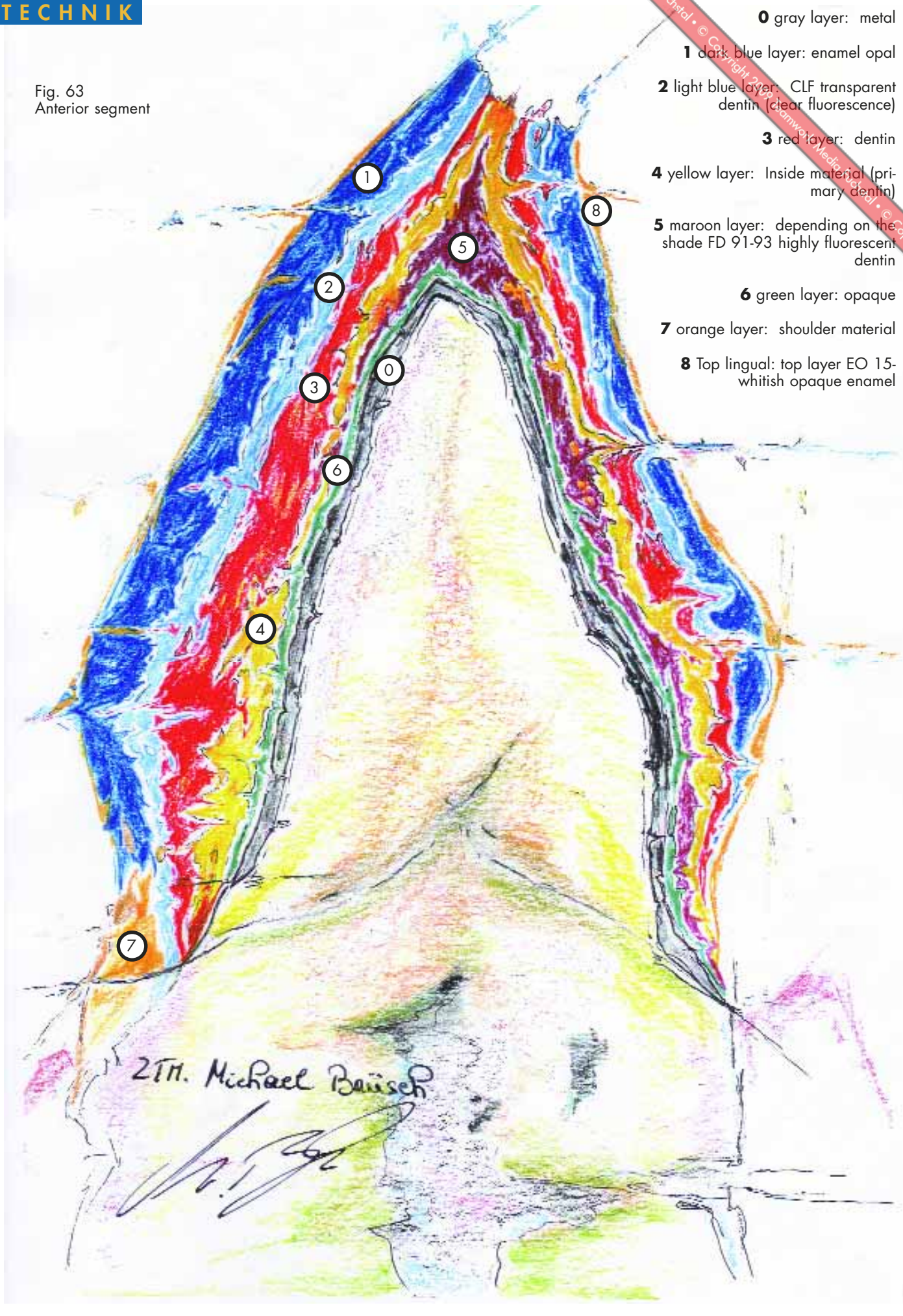


Fig. 63
Anterior segment



0 gray layer: metal

1 dark blue layer: enamel opal

2 light blue layer: CLF transparent dentin (clear fluorescence)

3 red layer: dentin

4 yellow layer: Inside material (primary dentin)

5 maroon layer: depending on the shade FD 91-93 highly fluorescent dentin

6 green layer: opaque

7 orange layer: shoulder material

8 Top lingual: top layer EO 15-whitish opaque enamel

The following anterior segments show the systematic layering:

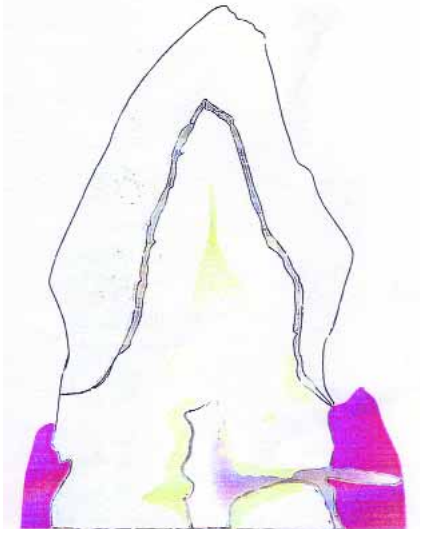


Fig. 63a metal frame

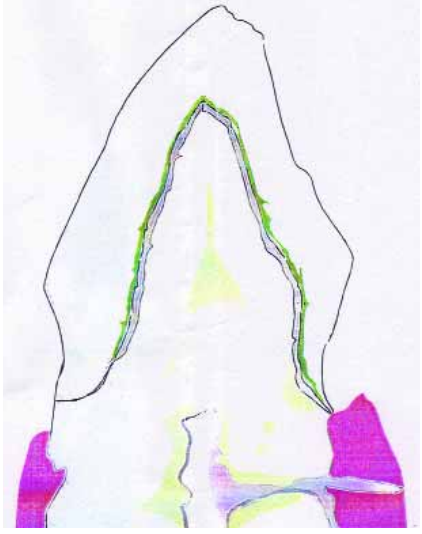


Fig. 63b opaque

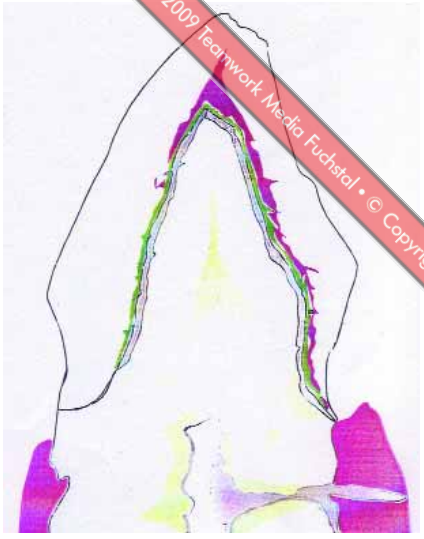


Fig. 63c FD 91-93 Highly fluorescent dentin to disguise the incisal edge of the framework

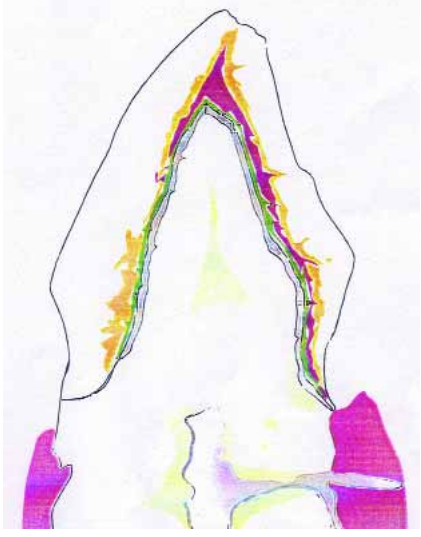


Fig. 63d Inside material and primary dentin to increase chroma and create depth

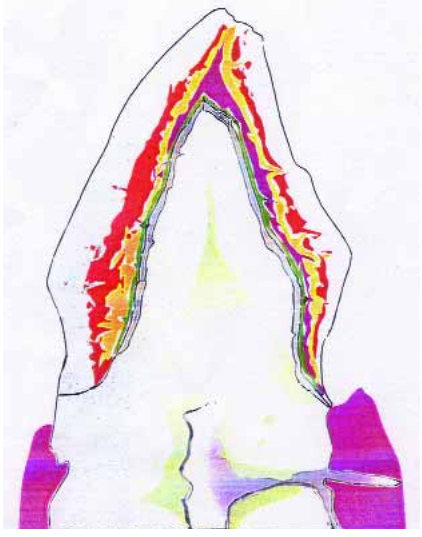


Fig. 63e Dentin build-up

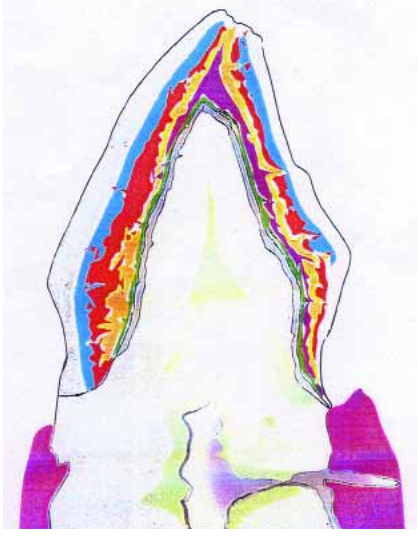


Fig. 63f Building the transparent dentin found in natural teeth with CLF (clear fluorescence) and an enamel layer.

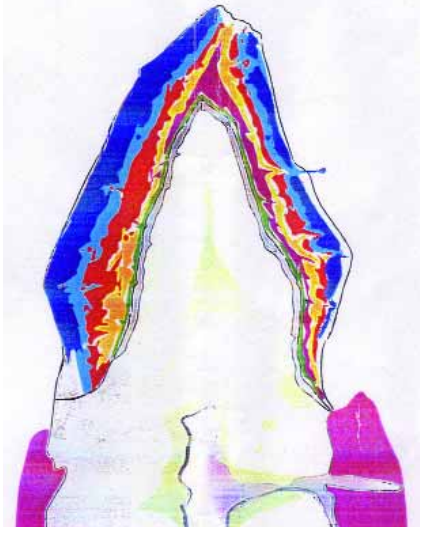


Fig. 63g Completing the shape with enamel opal, EO 15 and shoulder material.

Fig. 64
Posterior segment

1 yellow: primary dentin

2 red: dentin

3 light blue: CLF layer transparent dentin layer

4 dark blue: opal enamel

5 orange: EO 15 whitish opaque enamel

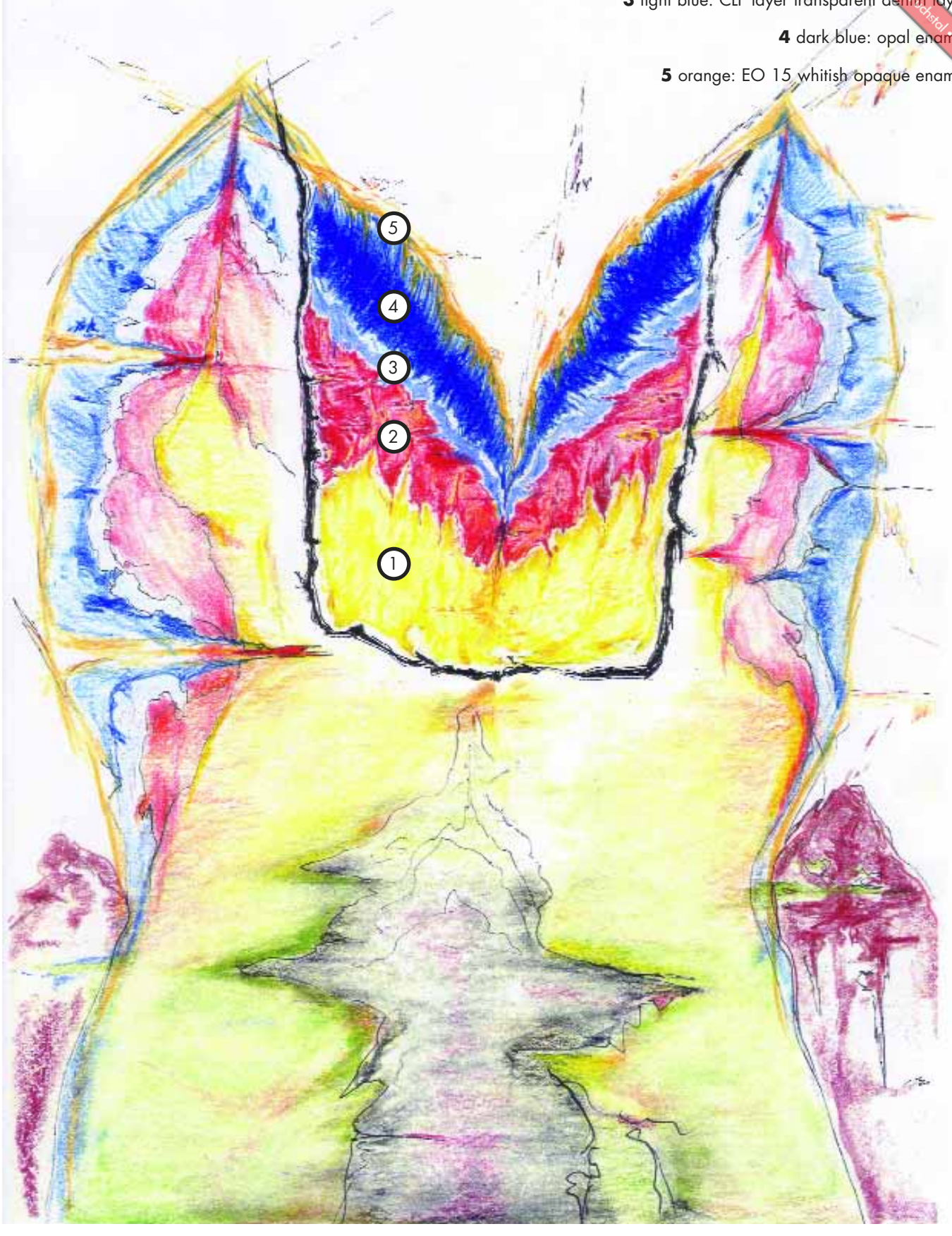


Fig. 65 In this segment the black outline indicates the primary dentin body.

Fig. 66 The layering structure of a natural tooth

Fig. 67 to 70 Sectioned views with layering illustrates the structure of the full ceramic inlay. The preparation depth provides the reference point for the materials used in each layer. The natural tooth is our model. The uppermost reference point is the occlusal prep margin, which serves as a guide for layering thickness and use of materials. Yellow: primary dentin, red: dentin, green: CLF, blue: enamel opal

Fig. 67 a and b depending upon the depth of the cavity, Inside and dentin materials are used.

Fig. 67c Additive dentin layering up to approximately 1mm below the prep margin.

Fig. 68 Analogous to natural tooth structure, the dentin layer is covered with transparent material (CLF)

Fig. 69 and covered with enamel opal.

Fig. 70 The opaque enamel as a final cover (EO 15) reinforces depth and imitates the reflection of the dentin analogous to natural enamel ridges.

Fig. 71 Gold crown versus full ceramic

Fig. 72 These individually layered ceramic inlays are not visible. This technique is also very suitable for veneers.

Fig. 73 Pre treatment situation. The laterals 12 and 22 are very crowded towards the labial. They should be brought as far as possible in a straight row.

Fig. 74 Perfect veneer preparations.

Fig. 75 Refractory dies are prepared. The high fluorescent material is layered on the dies to neutralize the light effect of the incisal edge of the preparation.

Fig. 76 Situation after the first correction bake using the advanced layering system.

Fig. 77
The highly fluorescent layer in the middle of the centrals, 11 and 21 evens out the differences in thickness between the restorations.

Fig. 78
Clearly visible bioesthetic layering. The highly fluorescent internal structure paired with opalescent material.

Fig. 79 The restoration in the mouth with a definite shade correction. At the patient's request, the lower anteriors will be adapted in shade and position to the uppers.

Fig. 80 The pre-treatment situation of a very complex case.

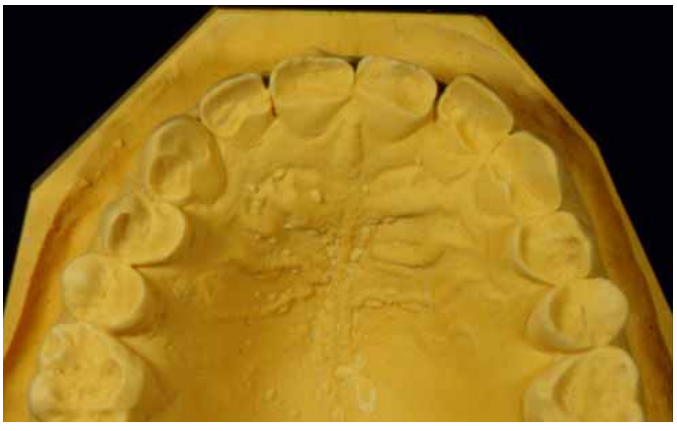


Fig. 81 The occlusal view of the pre-treatment model.

Second Patient case

This case was very complex (Fig. 80). Among the many problems were the decreased vertical, bruxism, enamel lesions, and the resulting greatly reduced amount of tooth structure (Fig. 81). To achieve the best possible result, it was decided to use sintered alumina copings due to the partial and/or full crown preparations in the upper arch. In the lower arch this combined sintered and high strength ceramics with aluminum oxide. (tech editor: not sure if this has been interpreted correctly, without illustrations to support) The supporting bakes were achieved with Inside material and Fludentin (fig. 82). One very nice feature of these powders is the minimal firing shrinkage (figs. 83 and 84). After the glaze, the function of the restorations is checked very carefully. For best results in complicated cases such as this, it is advisable to finish one arch before completing with the other. The lower arch is held in the corrected occlusal relationship with adhesively attached composite (GC Gradia) provisionals for 2 to 3 months to see how the patient adjusts to the new position. Corrections are easily made on the provisionals. The final lower restorations proceed after completing the adjustments to the occlusion. The 29 year-old patient desired lighter teeth in the upper arch, which can be seen in the mouth (figs. 86-89). The lowers will be completely restored to match the uppers.

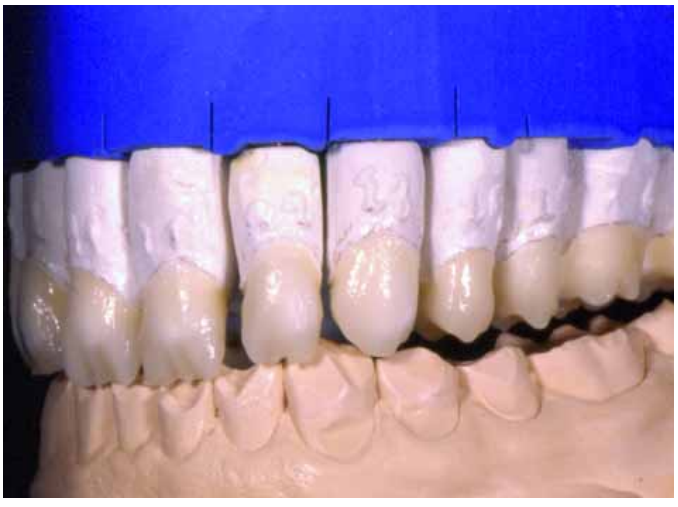


Fig. 82
The refractory dies covered with the highly fluorescent and Inside layers after the first supporting bake.

To be continued ❑

Fig. 83 The layering after the first complete build up and...

Fig. 84 ... after firing.

Fig. 85
The restorations after glazing on the master model with the prepared lower provisionals.

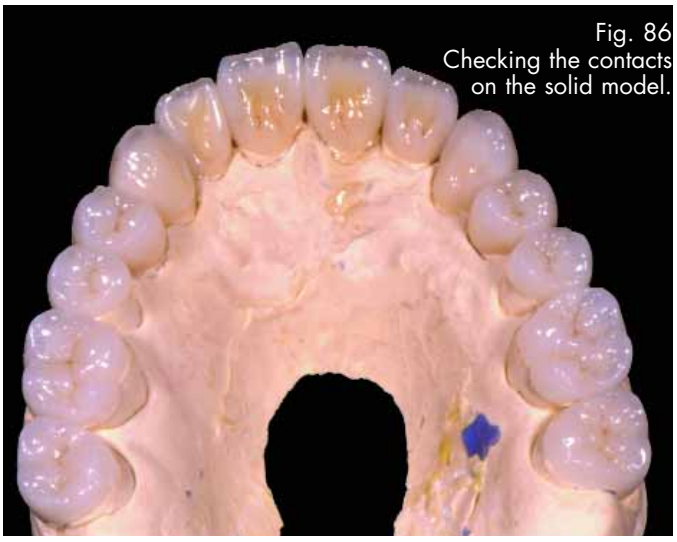


Fig. 86
Checking the contacts on the solid model.

Fig. 87
The anteriors in detail.

Fig. 88
The provisionals will remain in the mouth approximately 4 months.

Fig. 89
The restorations with the requested lighter shade.

Product Lists

Indication	Name	Manufacturer/Distributor
CAD/CAM System	Lava	3M ESPE
Investment material	Cosmotec Vest	GC Europe
Milling Al_2O_3	Procera	Nobel Biocare
Milling ZrO_2	Digident	Girrbach
Milling ZrO_2	Everest	KaVo
Milling ZrO_2	Cercon	Degudent
Ceramic Powders	GC Initial	GC Europe
Composite	Gradia	GC Europe

Biography
Michael Brüsch completed his training as a dental technician. In 1986 he acquired his Masters certification in Düsseldorf and from 1986 until 1989 was employed as laboratory manager with an emphasis on full ceramics. In 1989 he open his own dental laboratory and specialized in functional and esthetic dental work with emphasis on polychromatic layering for composite and full ceramic facings. He is an active member of the "Deutschen Gesellschaft für Ästhetische Zahnheilkunde (DGÄZ) and the "Dental Excellence-International Laboratory Group" He is also known for his unusual 3D presentations.

Ralf Dahl absorbed his dental training program from 1981 until 1985. From 1985 until 1988 he increased his knowledge in a commercial laboratory specializing in precious metal, ceramics and attachment work. He was employed as a technician in a private practice from 1988 until 1989 and as a supervisor until 1990. In 1991 he completed his Masters certification at the Masters School in Düsseldorf. Since 1994 he is the co owner and managing director of the MB Dentaltechnik GmbH. He is a member of the "Dental Excellence International Laboratory Group" and the DGÄZ. Ralf Dahl is a lecturer and co lecturer in hands-on courses nationally and internationally. He specializes in lectures on Build-up Technique in Ceramic-composite: functional and esthetic procedures for full ceramic inlays, onlays, veneers and full crowns as well as facings for crown and bridges in oxide ceramics.

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