A Ceramic solution with overlapping systems. Part 2

Systematic Bioesthetic Dental Restorations

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The esthetics of natural teeth is our model. What, then, could be more precise than declaring the internal structure of a natural tooth as the highest goal for dental restorations. In "dd" 8/2004 dental technicians Michael Brüsch and Ralf Dahl began to introduce their procedure for using the GC Initial Ceramic System. Additional possibilities using modern techniques such as CAD/CAM are illustrated in Part II using various patient cases. Included are an extraordinary build-up system illustrated with outstanding pictures and detailed case descriptions, pushing the boundaries of the new technologies.

Indication: Bioesthetics, Chroma, CAD/Cam-Restorations, high strength ceramics

The previous article in this series illustrated the upper arch restoration of a very complex patient case. Because of the distinct dropped vertical, bruxism, enamel lesions and greatly reduced tooth substance, and in spite of splint therapy, it made sense to do this case in two steps. After the upper restorations were adhesively cemented a new vertical was tested for 3 months against the long-term provisionals in the lower arch. The patient adjusted very well to the new vertical allowing the lower arch restoration to proceed (fig. 88). The provisionals were removed and the lowers were

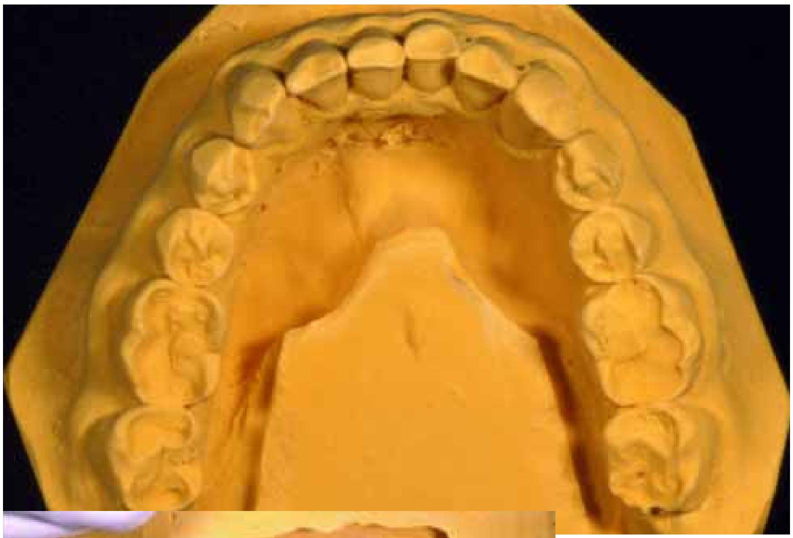

Fig. 88
The pre-treatment situation from the occlusal

Fig. 89 and 90
The mandibular preparation on the model.

Fig. 91
First correction firing of the sintered restorations from anterior to the first bicuspid.

Fig. 92
Detailed picture of the sintered anterior.

Fig. 93
Checking the function (protrusion)

Fig. 94
The restoration from the buccal

prepared for full ceramic crowns with circumferential porcelain shoulders (figs. 89+90). The lower anteriors and the first bicuspids were fabricated using a sintering technique on refractory dies (figs. 91+92,layering build-up see "dd" 08/04). For the remaining posteriors in the main chewing areas, restorations were made of aluminum oxide ceramic. The adaptation of the various restorations is perfect, even from different angles (fig. 93-96). The esthetics and the morphological shape of the teeth are very

Figs. 95 and 96 The occlusal view shows the perfect adaptation between the sintered ceramic and the aluminum oxide ceramic.

Figs. 97 and 98
Detail of the fossa from the occlusal.

attractive regardless of the material used (fig. 97+98). Clearly identifiable here are the effects in the upper and lower anteriors which were made with the fluorescent and Inside materials (figs. 99+102). They are responsible for the natural interplay of light in the crowns. Because of the internal structure, in the mouth the crowns appear natural, healthy and youthful befitting the patient's age (fig. 103-106). In the interproximals the Inside materials give the crowns a warm appearance.

The Inside materials can be used for cervical, interproximal shading and as primary dentins. With the help of the 11 different Inside powders it is possible to cover the whole color spectrum. In the problem areas, i.e. the lingual of anteriors and the central fossa in posteriors, the Inside materials usually replace the dentin. In this manner natural warmth develops simply with minimal layering. Additional powders are not needed.

Figs. 99-102
The restorations in the mouth.

Figs. 103-104 For comparison, the situation before treatment …

Figs. 105 and 106 … and after.

GC Initial and High capacity ceramics

The GC layering technique is as easy on high tech ceramics as on conventional frame materials. There is no difference in the procedure: exactly the same build up procedure is used on all. Only the various frame materials need special preparation and color modifications.

Today CAD/CAM manufactured high strength ceramics such as aluminum/zirconium oxide from offer a very wide range of applications. Fortunately the manufacturing quality of the frames has been equally perfected.

The exceptional physical properties of these ceramics have been described in other contributions and are not a part of this article.

However, as promising and simple as the handling of high strength ceramics seems, it is important to consider a few fundamental points.

With zirconium oxide there are two variations:
a) a white, more or less opaque, milled or sintered zirconium oxide.
b) a dyed in the corresponding shade sintered zirconium oxide.
The latter definitely offers, especially for standard layering, a more compatible color base for the standard tooth shade buildup.

But even a strong white zirconium oxide can provide the optimal base using the GC system.

A white neutral base allows the applied colors to appear very pure and genuine. The fluorescence missing from zirconium oxide frames must, however, be replaced with a thin coating of liner (AL) or frame modifier (ZR) to provide the natural fluorescence from inside the restoration (fig. 108).

The liners/modifiers can also be individually tinted with the fluorescing Initial stains (AL/ZR).

Figs. 107a and b The porcelain build up on CAD/CAM frames are done in the same way as the previously described materials. The only difference is the specific pre treatment of the base.

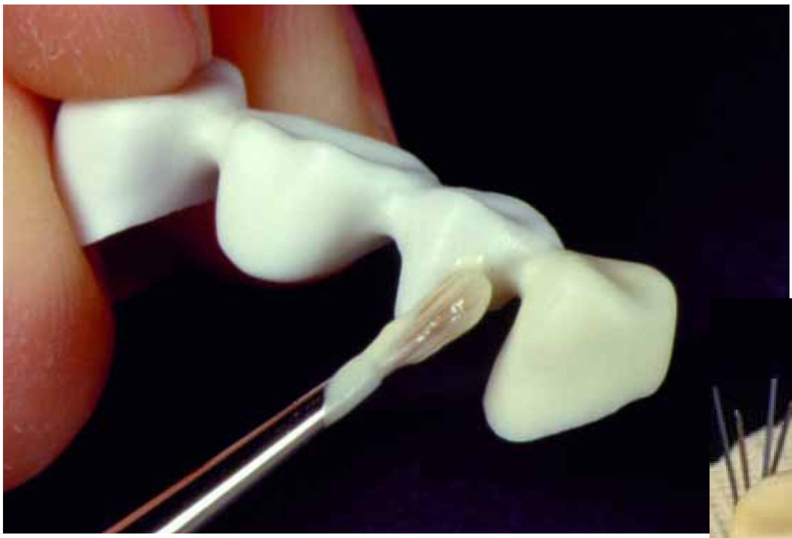

Fig. 108
The construction is treated with Frame Modifier. It allows the build up to begin on a base with the correct color.

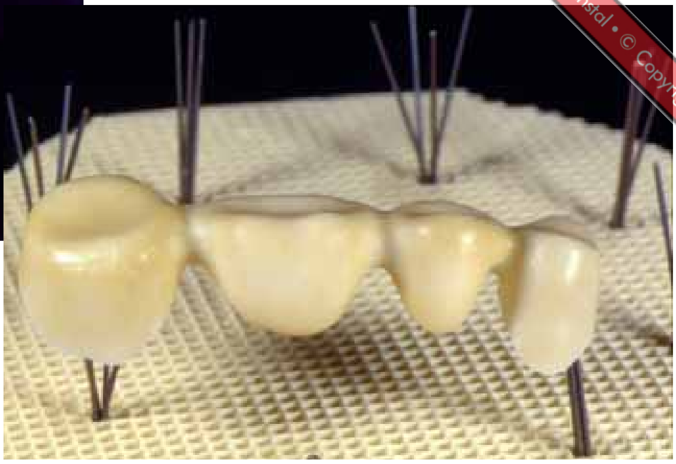

Fig. 109
Zirconium oxide crowns or bridges should always be fired on thin metal pins.

Fig. 110
The pontic surface resting on the gum tissue should be filled in with white opaque material to match the circumference of the adjacent white zirconium oxide crowns to produce the same color effect labially. If a colored material or only dentin is used, it will appear dark or gray in the mouth.

PRACTICAL TIP

When using uncolored zirconium oxide (or aluminum oxide) the color saturation of the liner (AL)/Frame-modifier (ZR) must be one shade darker for a normal 0.8 mm layer thickness!

When making A2 shades, the base chroma should be at least the color effect of A3. With aluminum oxide frames it should even be a "warmer" tone because the dentin colored frame material becomes continuously lighter with each firing. The result is that simply layered restorations (without intensified chroma) appear too light in the patient's mouth.
A similar appearance is seen with white, non-chroma intensified zirconium oxide restorations. The missing chroma and fluorescence on the frame causes a light, too white/gray appearance.
The Initial layering system simply compensates for this unwelcome "addition" and standardizes the procedure shown in figures 119 to 150 (See page 36 and 37).

It is not as simple to evaluate the optimal firing of AL/ZR ceramic. Improper firing often causes the incorrect shade seen frequently in AL/ZR restorations. Most furnaces fire 20°C-30°C lower, especially in the temperature firing range of the zirconium ceramics. All Initial ceramics, but particularly ZR/AL react to low firing temperatures with slightly limited transparency and color effects. On the other hand somewhat higher firing cycles cause no problems and actually support the color and transparency effects. The ceramic firing stability is unusually good, so that in most furnaces raising the end temperature by 10°C to 30°C is recommended in order to achieve the best outcome. At the same time the crowns and bridges should always be fired on thin metal pins (fig. 109). Direct contact with the firing tray or cushion should be avoided because it can reduce the ambient heat by as much as 10°C.

Incorrectly constructed or layered pontics are another reason for esthetic failures when using white zirconium oxide bridges. In general the pontics should be the same size as the circumference of the retainers and built with light material comparable to the actual zirconium oxide (fig. 110). Either the pontic should be milled directly in zirconium oxide or in the "normal" construction white opacious dentin (ODM1) should be fired under the pontic.

Fig. 111
The finished bridge

Fig. 112
Esthetic compromises are a thing of the past with the new materials. Except for ...

Figs. 113 and 114 ... inlay and partial crown bridges. The manufacturing process for these CAD/CAM frames produces many compromises.

If only dentin or colored modifiers are used, the pontics will appear either gray or too dark and intense in color.

Special attention should be paid to the frame design. All copings and bridge pontics should be reduced in shape a maximum of 1.5 mm.

If large amounts of unsupported porcelain remain around the zirconium frame massive tearing may occur. The very versatile zirconium oxide material has become a real alternative to classical restoration variations, since Initial ZR ceramic was introduced to the market.
Every shape and color variation nature presents can be easily reconstructed through the symbiosis of these two materials (figs. 111 and 112).

Limits of modern high strength ceramics

With all the euphoria surrounding the new high strength ceramics one must, however, be aware of the esthetic limits of the material. Inlay and _ crown bridge reconstructions, for example, are very difficult to control esthetically (fig. 113 and 114). In most cases the fit of these frames must be restored with circumferential ceramic margins. The very white or dentin colored margins of the partial crowns and inlays must be trimmed away and readapted with shoulder porcelain to obtain a perfect esthetic result. The question is whether the time invested justifies the result (figs. 115 to117). In any case these restorations present many compromises. In our opinion, these restorations are contraindicated.

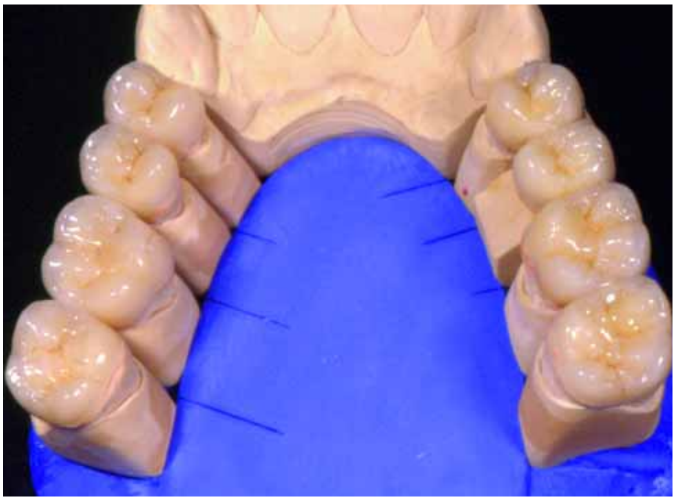

Fig. 115 The full restoration on the model

Fig. 116 In situ, the occlusal view of the restoration shows that the esthetics have been adapted perfectly.

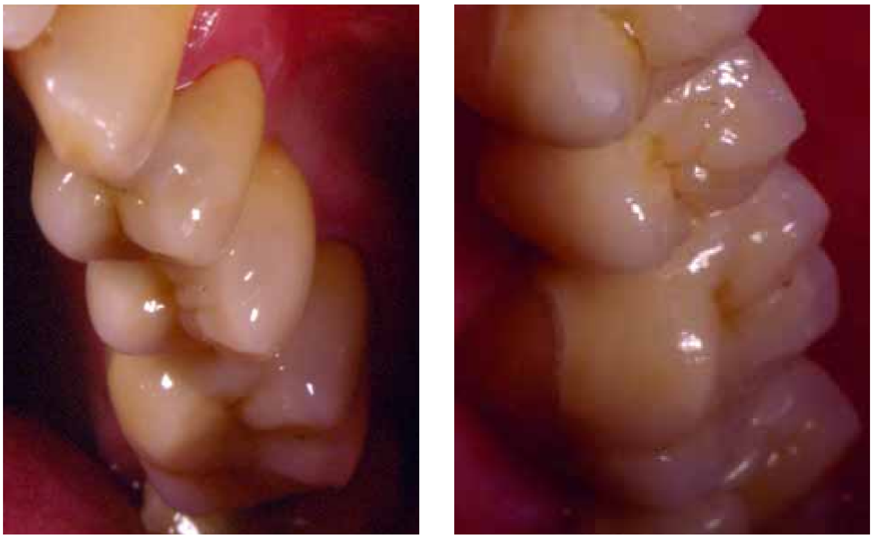

Fig. 117 and 118 The detailed pictures show the esthetic limits: The somewhat opacious zirconium material blocks light in the enamel of natural teeth. This achieves a shading difference along the prep margin.

When a partial crown preparation is required, the buccal tooth surface should be included in the preparation to insure a pleasing optical result in the esthetic area. Generally we would rather solve these types of cases with the classical method.

The opacious zirconium oxide material blocks light in the enamel of natural teeth, resulting in a color impact along the margin. The partial zirconium oxide bridge complies harmoniously with the occlusals and buccals of the different ceramics in the complete restoration.

As clearly seen in figure 118, the whitish opaque zirconium oxide along the gingival margins display a "light blocking " effect onto the enamel. To compensate for the difference in translucency a substantial preparation allowing for a 0.8 to 1.0 mm ceramic shoulder must be provided.

As little as possible, as much as necessary! Every preparation should take into account the physical material properties of the ceramic materials to be used in order to make the best possible esthetic and durable result.

Layering procedure on aluminum oxide ceramic copings




Fig. 119 Since aluminum oxide is a "dead" frame material lacking fluorescence, it is covered with a liner.

Fig. 120 Inside materials are applied on the cervical and proximal areas.

Figs. 121 and 122 The light refracting edges are covered with highly fluorescent dentin FD91 to 93, the body is covered with Inside material.




Figs. 123 and 124 A thin dentin body is built up.

Fig. 125 The enamel table (shield) is layered.

Fig. 126 Then a cutback in the incisal third of the enamel table down to the high fluorescent material.

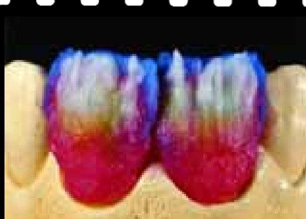


Fig. 127 Applying the FD91 shield.

Fig. 128 Applying stains and Inside material. The GC Initial stains are almost exclusively fluorescent. They can also be used for internal layering.

Fig. 129 Covering layer of CLF over the whole inner build up.

Fig. 130 Final shaping with opalescent enamel material.


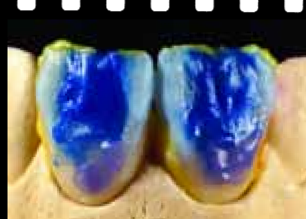

Fig. 131 First bake.

Fig. 132 Correction bake with translucent material. The body is supplemented with colored translucent materials and opal enamels.

Fig. 133 The result from the labial …

Fig. 134 … and from the palatal.

Layering procedure for bridge constructions made with zirconium oxide ceramic:

Fig. 135 Fired Frame - Modifier on the zirconium oxide frame.

Fig. 136 Build up under the pontic with whitish opaque modifier.

Fig. 137 Cervical Inside material and highly fluorescent dentin covering the refractive edge.

Fig. 138 The complete frame is thinly covered with a corresponding Inside material.

Figs. 139 and 140 A thin layer of dentin is applied.

Fig. 141 The enamel table or shield is made.

Fig. 142 Cutback in the incisal area down to the highly fluorescent dentin.

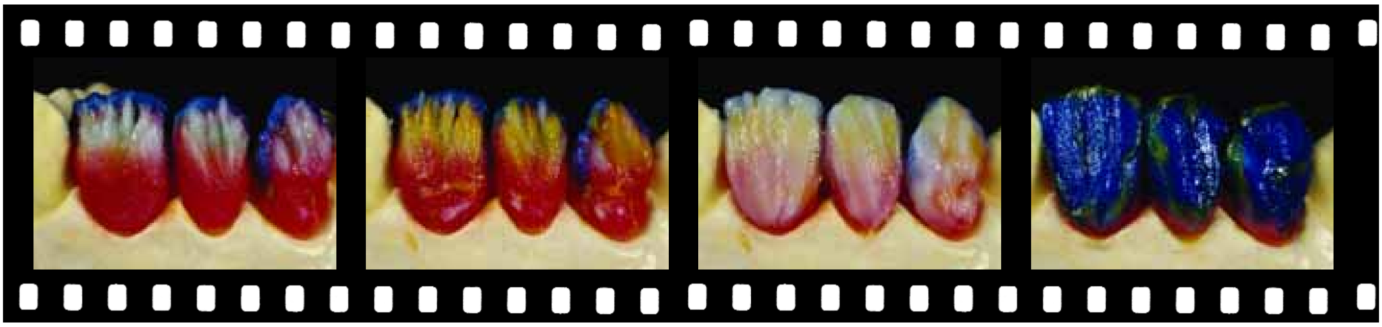

Fig. 143 Applying the internal FD 91 shield.

Fig. 144 Layering the desired internal structure with Inside materials or stains.

Fig. 145 Covering layer over the internal layers with CLF material.

Fig. 146 Completing the final shape with opalescent enamel.

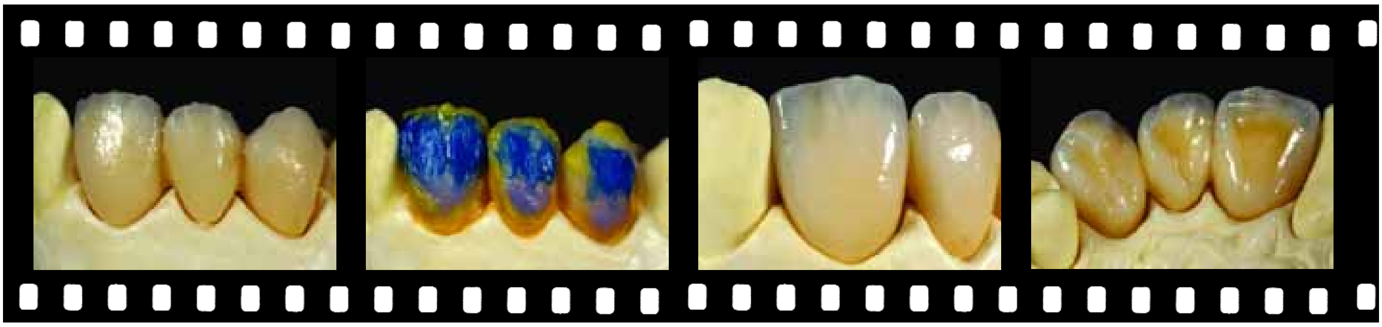

Fig.147 The restoration after the correction bake.

Fig. 148 Correction made with translucent materials and opalescent enamels.

Fig. 149 The final result from the labial…

Fig. 150 … and from the palatal.

Figs. 151 and 152 The detailed result of a CAD/CAM restoration.

Fig. 153 We decided to restore 11 with a zirconium oxide and tooth 21 with a ceramic fused to metal crown with a porcelain shoulder.

Fig. 154 You can no longer tell where the ceramic fused to metal crown and the full ceramic crown were inserted.

Third Patient Case

This patient was mostly unsatisfied with her esthetic situation. Tooth 11 had several fillings and tooth 21 was non vital and had darkened (fig. 153). She wanted a natural, appropriate and healthy appearing anterior restoration. In this case we decided to restore 11 with a zirconium oxide crown and 21 with a ceramic fused to metal crown with a porcelain shoulder (fig. 154). Of course there are very opaque zirconium oxide materials especially those used for CAD/CAM. However, when the preparations are very dark, depending on the thickness of the coping, they can produce a gray shimmer. In this case we decided upon a ceramic metal crown as an experiment to see the color comparisons between the materials. Normally a sintered crown would be used on tooth 21 with opaque powder A1 mixed with an equal amount of FD-91 fired directly onto the refractory die to create an opaque foundation. This is a very reliable method to cover even dark metal posts.
For single restorations, sintered crowns still have the most applications and offers the highest esthetic potential. However, it does not allow any mistakes and requires the technician and the dentist to have a great deal of knowledge about adhesive cementation.
On the other hand, ceramic metal/ aluminum/zirconium oxide restorations can be easily cemented in the conventional manner without rubber dams or glass ionomer cements. However, their application on very darkly stained teeth is limited because their opacious qualities are similar to that of dentins.
The restorations on 11 and 21 shown here were made during the developmental phase of Initial ceramics and provided the first indication of the performance of the layering philosophy. The different materials used to restore the teeth are not discernible from each other.

Ideal beauty for the 21st century – made with zirconium oxide

Fig. 155
For this patient the teeth 13 thru 23 were to be restored with zirconium oxide crowns.

Fig.156 More and more requested: the wish for natural, "beautiful", lighter and more alive looking dental restorations.

Abb. 157
Ausgangssituation

Fig. 158
The whole upper arch and the lower posteriors were restored with zirconium oxide. The lower anteriors prepared as veneers were done in sintered technique.

Figs. 159 and 160
The bioesthetic restoration in the mouth.

Fourth Patient Case

In this case, as well, the patient desired a bioesthetic restoration and a pronounced improvement in her oral environment. The previously described layering procedure was used on these restorations (see Figs. 135 to 150). The upper teeth were made with zirconium oxide crowns and the lowers were veneered using the sintered technique-the color compatibility of the different materials is perfect (figs. 158 to 160).

Fig. 161 and 162
This layering procedure cannot only be used within overlapping ceramic systems, but is equally transferable to hybrid composites.

Outlook

The impact of natural teeth is unparalleled. This layering system will enable you to imitate nature perfectly. Not only can you use this layering procedure within overlapping ceramic systems, but you can also transfer its principles to hybrid composites. No matter which system you use, it will always let you achieve the desired bioesthetic outcome (Fig. 161 and 162).

Acknowledgements

Our thanks to the dentists Dr. Gernot Mörig, Dr. Uta Saneke-Schedel, Dr. Gilbert Varzandeh of Duesseldorf for their trusted cooperation with the patient cases presented in Parts I and II. q

Product Lists

Indication	Name	Manufacturer/Distributor
CAD/CAM-System	Lava	3M Espe
CAD/CAM-System	Procera	Nobel Biocare
CAD/CAM-System	Digident	Girrbach
CAD/CAM-System	Everest	KaVo
CAD/CAM-System	Cercon	DeguDent
Investment material	Cosmotec Vest	GC Europe
Hybrid Composite	GC Gradia	GC Europe
Ceramic Powders	GC Initial	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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