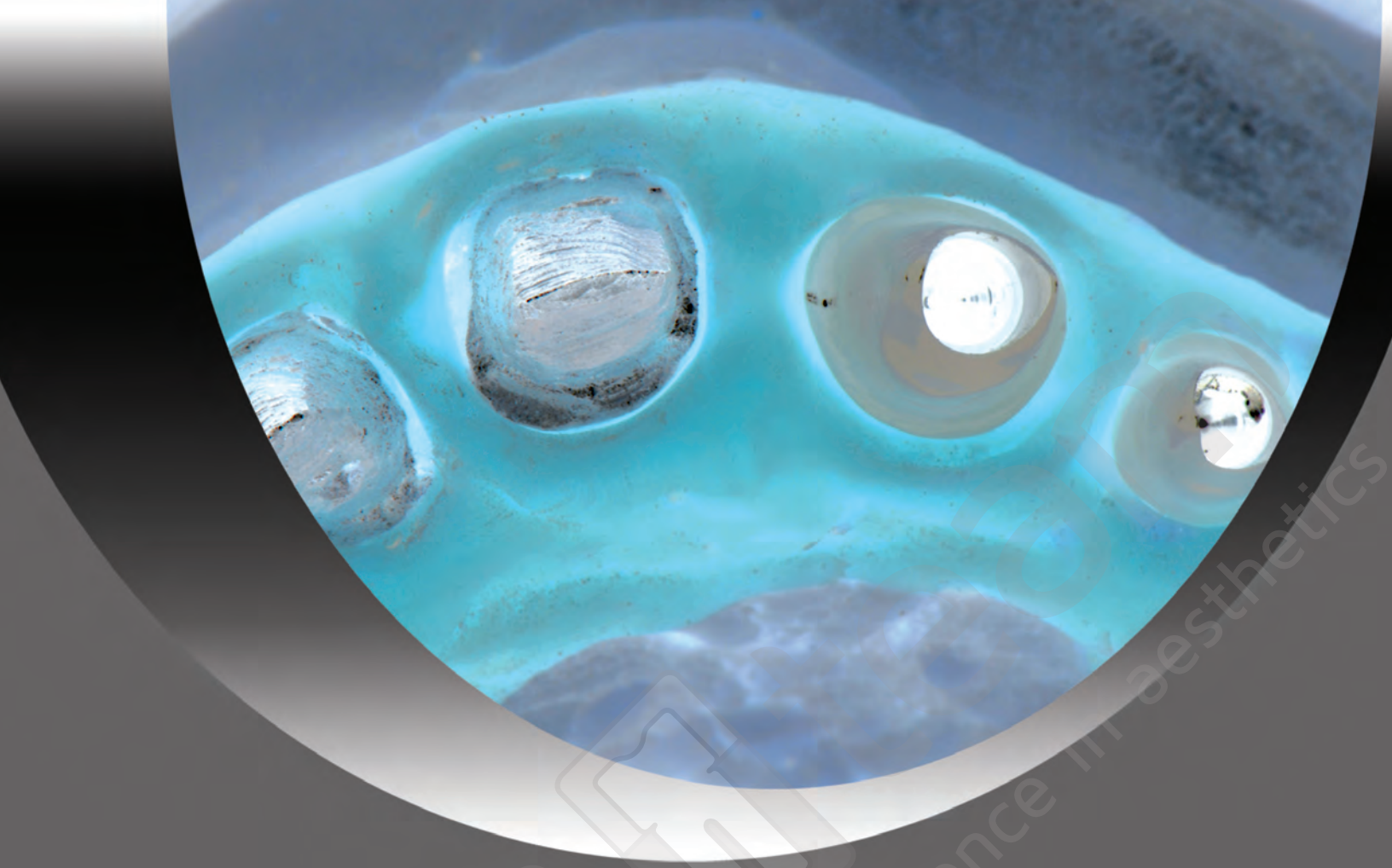

Luc and Patrick Rutten were born in Tessenderlo, a town in the Flemish part of Belgium. Although they received most of their dental technician training in Brussels (1976-1979), they moved to Cologne, Germany (1979-1984) and specialized in crown and bridgework, ceramic reconstructions, milling techniques and implantology. In 1985 they set up the Dental Team, a dental laboratory for innovative dental technology, specializing in aesthetic-cosmetic tooth replacement in ceramics. They have lectured throughout Europe and at international conferences. In addition to numerous publications in renowned international journals, Luc and Patrick Rutten are co-writers of the following books: "Implant Aesthetics", "Keramische Restaurations-techniken" and "Implant Prosthodontics".

Excellence in Dental Aesthetics: Guided Aesthetic Implantology

This case describes the use of zirconium oxide in a patient who required extensive surgery and the step-by-step procedure, from design to restoration

Introduction

The expectations of patients who must undergo extensive treatments are often very high. The response plans are usually very long and the patient is required to have a lot of patience. And this is the difficult part in this important phase of life. The decision for a given type of treatment is made after weeks or even months, at which point the only thing the patient wants is a new smile as soon as possible. It is important to provide explanations and visual examples of the possibilities of intervention, to obtain the patient's confidence and avoid disappointment. The aesthetic needs must also be considered, which often depend on fashion. Due to the complexity of the treatment and to ensure optimal results often there is a need for very specialized dental care such as implantology, periodontology and/or orthodontics. In implantology, aesthetics and predictability are important. In addition to more in-depth knowledge of the professional team, new techniques provide continuous improvements in the field of predictability (e.g. Nobel-Guide) and the results obtained with implants in the esthetic zone.

Considerations on the patient

In recent years, the patient's expectations with regard to aesthetics have significantly changed. Therefore the lady was not satisfied with her first prosthetic rehabilitation. For the dentist and dental technician this means having to predict the outcome of the final aesthetic result when designing the implant treatment, to avoid disappointment and to satisfy the patient.

In recent years, the possibility of obtaining excellent aesthetic and functional results through the use of implant restorations have improved considerably. New surgical methods and new materials provide an important basis for the adhesion of soft tissues and their stability.

In our laboratory the Procera structures in ZrO_2 do the lion's share with regards to ceramics. Zirconium dioxide is a biocompatible, aesthetic, functional, highly stable ceramic material and its use opens up new possibilities. The CAD/CAM technology applied in dentistry reduces the efforts of manual labor, such as modeling and casting of metal alloys. Thanks to more accurate digital design processes the procedure is standardized, reproducible, predictable and of consistent quality.


Fig. 1


Fig. 2

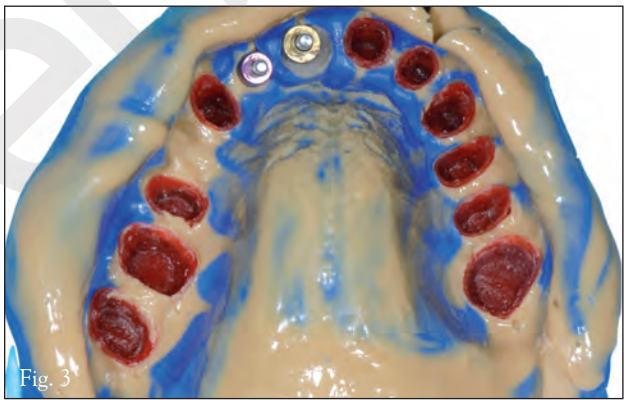
Fig. 3


Fig. 4

Fig. 1: Patient with an unfavorable gingival framework

Fig. 2: Insertion of implants after gingivectomy of the front sector

Figs. 3 and 4: Galvanized impressions and transfer caps in composite

The case described is of a 35 year old patient with an unfavorable gingival framework, the so-called "Gummy smile" (Fig. 1). Clinical and radiological investigations revealed partially extended cavities.

It was decided to cover part of the front teeth with crowns. The treatment plan included gingivectomy of the front sector and the insertion of implants (Replace Select, Nobel Biocare, Sweden) in the second quadrant (Fig. 2).

Final restoration

Considerations on the structural design – Individual, galvanized impressions and composite transfer caps have been made on the natural abutments (Figs. 3 and 4). This impression with composite transfer caps will provide us with a master model and complete information on the gum and papillae. It is possible to take into account and respect the importance of the emergence profile only when correct information on the oral situation is available. A solid foundation is essential for good results. In this patient, as often happens now, natural abutments are contiguous to abutments on implants, a particular challenge for the dentist and dental technician. As we always do in our laboratory the natural abutments were covered in silver. It is worth dedicating time and material, since silvering makes the abutments much more resistant to abrasion and the surface appears perfectly homogeneous. How do you create a master model of this kind? After galvanization the abutments are completed in composite and are fitted with a "dowel pin".

Above the "dowel pin" they are prepared in core, reinserted in the impression and fixed with adhesive wax. To create the master model the duplicates (Replace Select, Nobel Biocare, Sweden) are screwed or, depending on the system, inserted in


Fig. 5

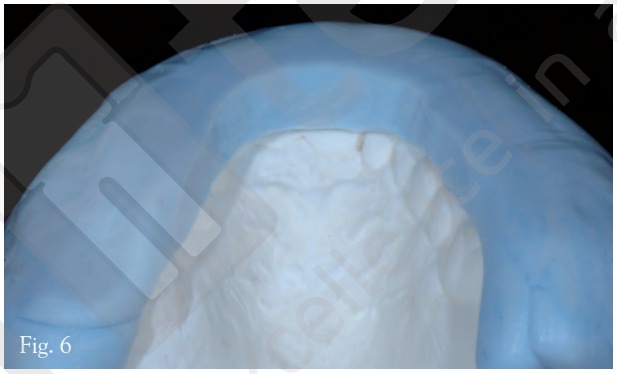
Fig. 6


Fig. 7


Fig. 8

Fig. 5: A plaster model of the temporary restoration

Fig. 6: Silicone lip mask

Figs. 7 to 9: Optimal information on the gingiva around the implants


Fig. 10

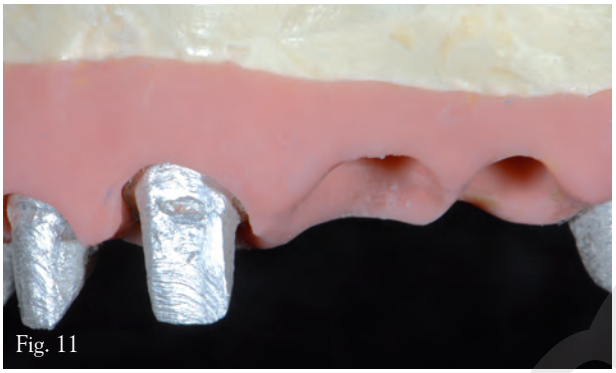
Fig. 11

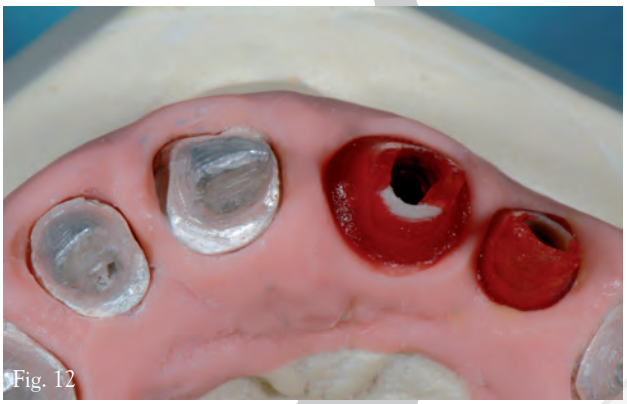
Fig. 12


Fig. 13

Figs. 10 and 11: The perfect contour around the implant

Figs. 12 and 13: The contouring of the abutment agreed to with the dentist.

the pillar of the impression. We always work with a gingival mask that is stable, but soft and removable. Besides providing a solid foundation, we believe that a clean and perfect master model is a "visiting card" for the laboratory.

The plaster model of the temporary restoration is very valuable for subsequent planning of the technical operating phases (Fig. 5). The silicone lip mask (Fig. 6) of the temporary restoration serves as a reference in every operational stage. For a proper end result it is necessary to proceed in a controlled manner. In this case Dr. Gamborena, San Sebastian/Spain gave us excellent information on the gingiva around the implants (Figs. 7 to 9).

For the technician it is often a problem if the impression is taken with a standard stump. The gingiva around implants has the diameter of the impression stump, but in general this is not the desired gingival contour. We need to produce a contour to ensure support for soft tissue, and if so how? In this critical phase it is easy for the technician to make mistakes because he does not have the necessary information.

The dentist has the best knowledge of the gingival conditions of his patient, and he should be the one to identify the standard stumps for the impression. The gap is filled with light-cured composite until we have an ideal contour. Sometimes the diameter even is too large. This figure shows that the standard stump has been reduced, the pressure on the gum was excessive, which may cause an apical shift of soft tissues, and an extension of the completion in composite.

The imprint shows the perfect contour around the implant in detail, to comply with the emergence profile (Figs. 10 and 11). The scope of the impression of the final situation is to allow the technician, at an inter-proximal level, to control the architecture of soft tissues (soft tissue topography) between the implants and on the buccal side, support the gum in a targeted manner by means of a crown. These figures provide us with detailed information on the oral situation. It is clear that the soft tissues have been configured using custom abutments. For proper configuration of the supra-gingival abutment, the space around the duplicate is now filled with composite. The contouring of the abutments is functional to the clinical case and in our opinion should always be agreed to with the dentist (Figs. 12 and 13). In this case, the dentist has already set the rules of the game.

Instead of wax it is suggested that the custom abutments be made in modeling resin, because they are much more stable. Once the abutments

are completed they can be milled in the final shape. Thanks to soft gingival mask, the stable abutments in composite can be removed from the model without problems. It is equally simple to adapt the preparation edges and the closing edges of the abutment to the gingival profile. The edge of the preparation is bevelled shaped to provide a stable base for the crowns. With the aid of the 3D-CAD Design-Software (Nobel Procera, Goeteborg/Sweden) the shape of the abutments was practically generated automatically.

To make a structure for the crowns in zirconium dioxide, the channel for the screws is eliminated with a water cooled turbine and the abutment is lightly finished (Figs. 14 and 15). The accuracy is optimum and the preparation edge has a configuration that is functional to the gum. The two abutments in zirconium dioxide are screwed in the respective quadrants on analogues of the model (Figs. 16 to 18). The buccal and lingual view shows that we used and are using the natural stumps as models. The configuration and the inclination of the axis are similar to the stump. For optimum, tension free accuracy, the abutments are milled with an inclination of 2°. On the lingual and palatal side the preparation edge of the abutments is always supra-gingival. In this way, after fixing, the dental technician can visually inspect the cementation crack and eliminate any surplus. Looking at the incisal abutments it is noted that the stumps are the same size.

The part of the abutments between the edge of the preparation and the base of the implant must be concave, so that the gum is not being pushed towards the apical and its level is not unintentionally modified (Figs. 19 and 20).


Fig. 14


Fig. 15


Fig. 16


Fig. 17

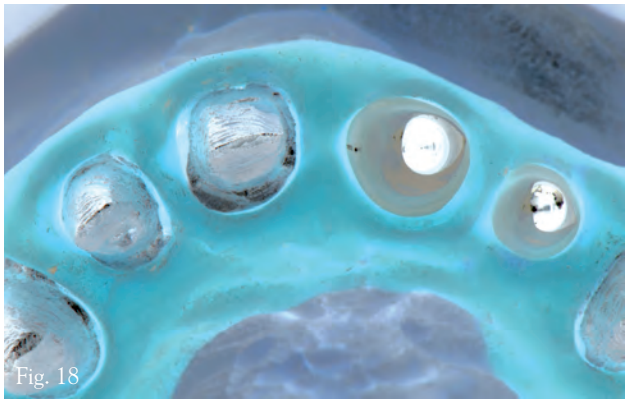
Fig. 18

Figs. 14 and 15: Eliminating the channel for the screw with a water cooled turbine

Figs. 16 to 18: The two abutments in zirconium dioxide screwed in the respective quadrants of the mimics


Fig. 19

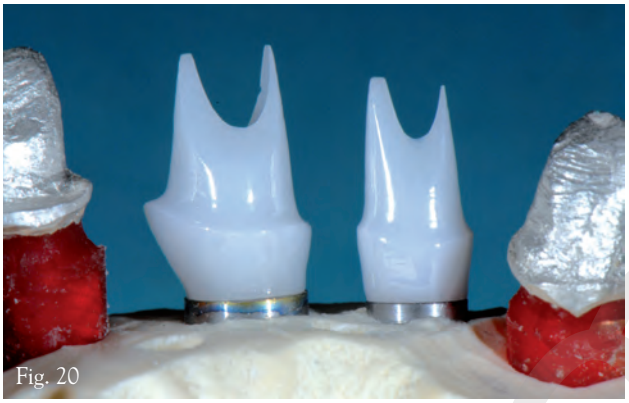
Fig. 20

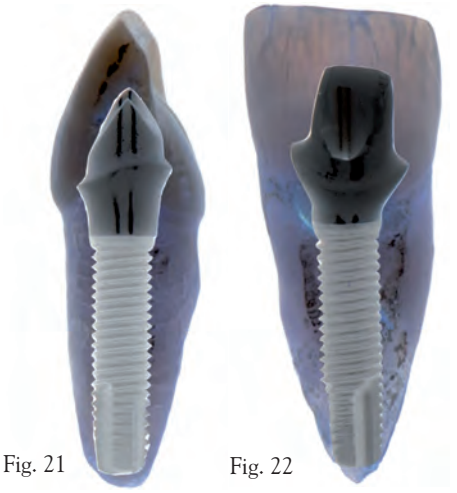
Fig. 21

Fig. 22


Fig. 23


Fig. 24

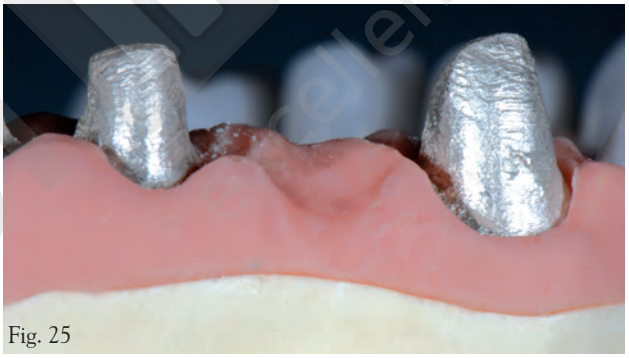
Fig. 25


Fig. 26


Fig. 27

Figs. 19 and 20: Concave configuration of the part of the abutments between the edge of the preparation and base of the implant

Figs. 21 and 22: The implant replaces the natural root and the customized abutment has a proper design

Fig. 23: Water cooled turbine for grinding

Figs. 24 and 25: Optimal design of intermediate element

Figs. 26 and 27: Oval shape of intermediate element

Fig. 28: The '"Ovate Pontic" meets the requirements of the intermediate

Fig. 29: Model with provisional in articulation

Fig. 30: The incisal silicone mask is configured automatically when the articulator is closed

The sub-gingival part of the abutment, which after being screwed to the implant is in close contact with soft tissue, should be polished: first with a low speed rubber disk and then with diamond paste for polishing. After this treatment the surface is as smooth as a mirror.

Figures 21 and 22 show what must be done: the implant replaces the natural root and the customized abutment has a correct design with bevelled preparation to ensure the stability and duration of the restoration. Our goal is to "adapt" the peri-implant trend to the soft tissue, thereby creating a natural look.

Final restoration

Preparing for veneering – If you need to optimize a structure in zirconium dioxide by grinding, it is recommended to exercise reduced pressure and possibly use a water cooled turbine (Fig. 23). Caution with this procedure serves to avoid impairment and limit the transformation of the crystal grid structure of the superficial zirconium dioxide from tetragonal to monoclinic.

With regards to aesthetics and phonetics, the intermediate elements are always problematic. The optimal design for the intermediate element should close the gap, ensure stable contact with the gum and at the same time allow for proper hygiene (Figs. 24 and 25).

Since when taking the impression the architecture of the soft tissues laboriously built collapses quickly, the contact area of the master model is reduced with a special resin cutter, just to ensure correct positioning of the intermediate element. Figures 26 and 27 show that the intermediate element is solid and has an ovoid shape, to ensure that the ceramic structure is perfectly sized. The structure has an anatomical shape which is reduced on average by 1.5 mm. For product characteristics (biocompatibility, uniformity, ease of polishing and mirror finishing) the basal surfaces of the structure in zirconium dioxide can be placed directly on the mucous membranes.

In our opinion, the "Ovate Pontic" meets the requirements of the ovoid shaped intermediate element (Fig. 28). The concept of "Ovate Pontic" is simple and logical: the root is amputated in correspondence with the intermediate convex.

The intermediate must also have this exact shape. With regard to hygiene procedures on an "Ovate Pontic", a patient with average experience can perform this perfectly with Superfloss. After planning and structuring are completed, the crowns and bridges milled in zirconium dioxide are ready for veneering. This however, does not mean that we want to proceed without any planning and structuring. Ceramic coating must also be scheduled. To proceed in a targeted and controllable manner, the model with the temporary restoration is placed in articulation with the mandible (Cross-mounting)(Fig. 29). An incisal silicone mask is produced, which is configured automatically when the articulator is closed (Fig. 30), providing important information for the control of future restorations. The labial or buccal silicone mask is used to achieve the Procera abutments, caps and bridges. The silicone incisal mask is now used as a reference for ceramic coatings.

In the articulator, the upper jaw model of the temporary restoration is replaced with the implant model (Figs. 31 and 32). The incisal mask is placed over the final model of the mandible. The gap between Procera crowns and bridges are checked again to ensure optimal spatial relationships.

At this point the space available for the ceramic coating, in terms of lip length and size, is clearly defined. The master implant models with crowns and bridges in zirconium dioxide are in articulator, ready for coating. It is known that there are many disputes over zirconium dioxide. However, cracks, late breaks or chipping (partial detachment of ceramic) must not necessarily be part of the daily routine. Knowledge of merchandise is essential for the dental laboratory! Zirconium dioxide is not alumina nor a dental alloy and should be treated differently. Since we have been working closely with the engineer Michael Tholey Zahnfabrik of Vita Zahnfabrik, Bad Saeckingen/Germany we have not had any unpleasant surprises. The configuration of a structure that provides support is certainly an important factor, but not the only one! Before applying the ceramic a regenerating baking should be performed to ensure that the zirconium dioxide has assumed a tetragonal crystal structure. As a result of different operational phases, such as milling with a water cooled turbine

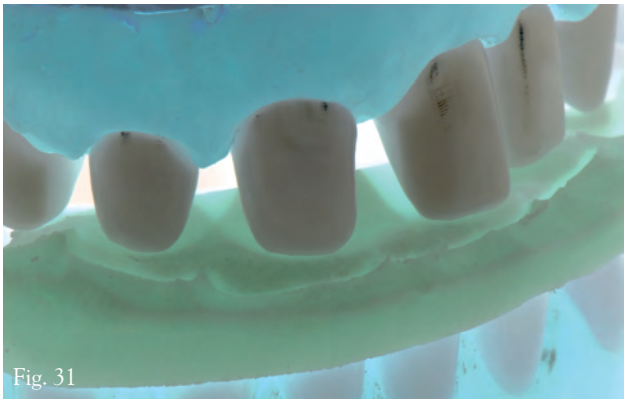
Fig. 31


Fig. 32


Fig. 33

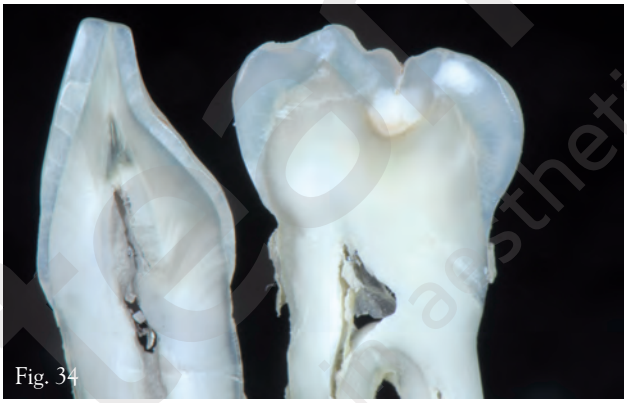
Fig. 34

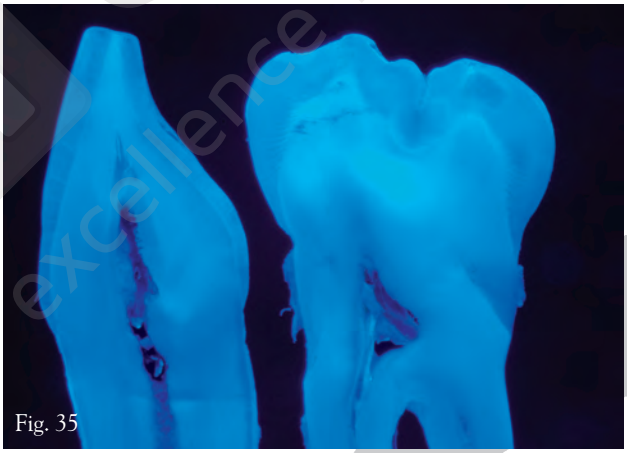
Fig. 35

Figs. 31 and 32: Replacing the upper jaw model of the temporary model with the implant

Fig. 33: Master Model with caps and bridge in zirconium dioxide

Figs. 34 and 35: Section of natural teeth observed in ultraviolet light

or sand-blasting (which we do not use), the tetragonal structure is transformed into a monoclinic. Without regeneration baking, the monoclinic shape could give rise to the formation of cracks. Regeneration baking is performed in a ceramic furnace at 1,050°C without vacuum, holding time 15 minutes. Slow cooling is not necessary because the ceramics has not yet been applied. This first step is already important. The master model shows the caps and bridge with finished intermediate elements in Procera zirconium dioxide (Fig. 33).

The junctions between the pillars and intermediate elements have a section of 6 mm^2. The junctions with the intermediate element must be as massive as possible: however, there is sufficient space for anatomical structuring and chromatic configuration compliant with the natural model. When designing the structures in zirconium dioxide using the NobelProcera system we took all possible care to obtain an optimum shape with regards to strength, esthetics and support for the ceramic.

We are often asked which ceramic material to use for baking wash. A logical answer comes from mother nature. Sections of natural teeth observed in ultraviolet light show what to do (Figs. 34 and 35). Natural dentin is highly fluorescent and our task is to copy nature as closely as possible.

It is therefore appropriate to apply high fluorescence over caps and bridge to ensure a natural distribution of light in the restoration.

The ideal materials to copy the innermost secrets of nature are fluorescent shoulder materials called Effect Liner (Vita Zahnfabrik, Bad Säckingen/Germany), here photographed in reflected and ultraviolet light (Figs. 36 and 37). After baking the Effect Liner masses have a larger particle size, which may be surprising for the high melting temperature.

But in order to give these masses fluorescence, additional materials are used, which, after baking, will give a slightly less smooth surface.

Effect Liner masses are available in 6 colors (from EL1 to EL 6): white, beige, brown, yellow, orange, and green-yellow (Fig. 38). There is a correlation table that facilitates the choice of right Liner type: for example for 3M2 EL2/EL6 is used in a ratio of 1:1. The first thin ceramic layer applied as a wash (Fig. 39) is very important: by baking at an extremely high temperature (970°C, under vacuum) it is melted into the zirconium dioxide ensuring a chemical-mechanical bonding between the structure in zirconium dioxide and the ceramics. At this temperature the ceramic masses become very fluid and are therefore able to penetrate into all structural micro-retentions of the zirconium dioxide. In this way an optimal interface is created between the structural material and ceramic coating. Under UV light the structures in zirconium dioxide generate dark shadows, even in the cervical area (Figs. 40 to 43). The effect of the Effect Liner masses is particularly apparent when observed under UV light. Fluorescence is the ability of a body to absorb radiant energy and transfer it again under different wave lengths. The sections have shown that the dentin is much more fluorescent than enamel, giving rise to the distribution of light inside the tooth. Shadows are not formed and with ceramic restorations these must not be created. The use of the Effect Liner masses ensures greater light conductivity and increases the transmission into natural tissues. The Effect Liner can be used both for 3D Master coloring and classic Vitapan (Vita Zahn-Fabrik, Bad Säckingen/Germany). As already mentioned, with the Effect Liner masses the fluorescence is controlled.


Fig. 36


Fig. 37


Fig. 38

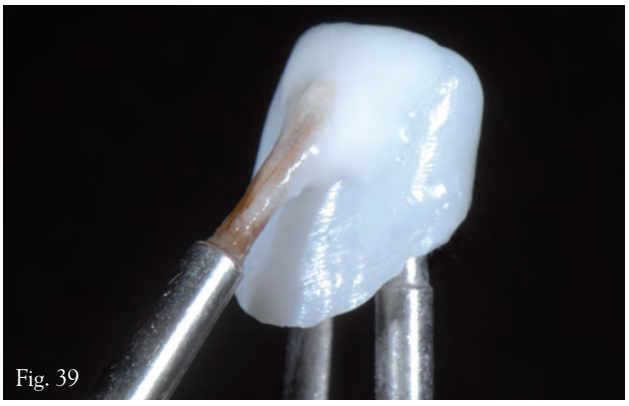
Fig. 39

Figs. 36 and 37: Fluorescent shoulder mass Effect Liner

Fig. 38: Effect Liner masses are available in 6 colors

Fig. 39: The first thin ceramic layer applied as a wash

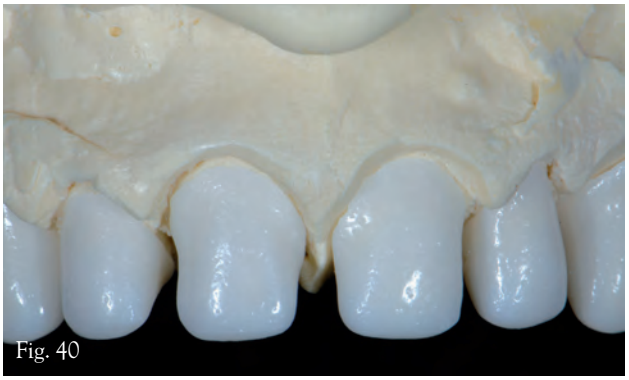
Fig. 40

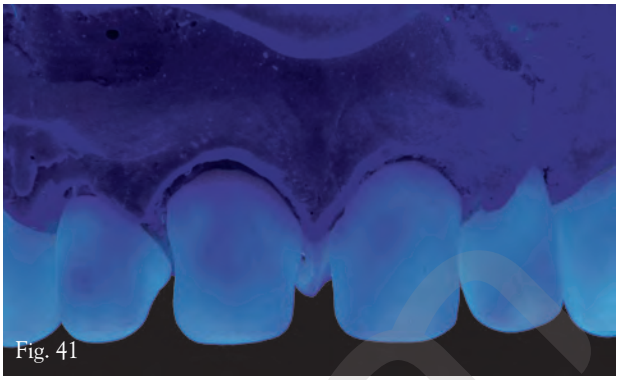
Fig. 41


Fig. 42

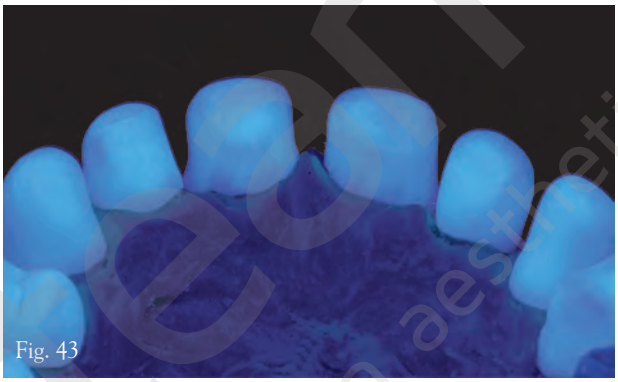
Fig. 43

Figs. 40 to 43: In UV light the structures in zirconium dioxide generate dark shadows also in the cervical area

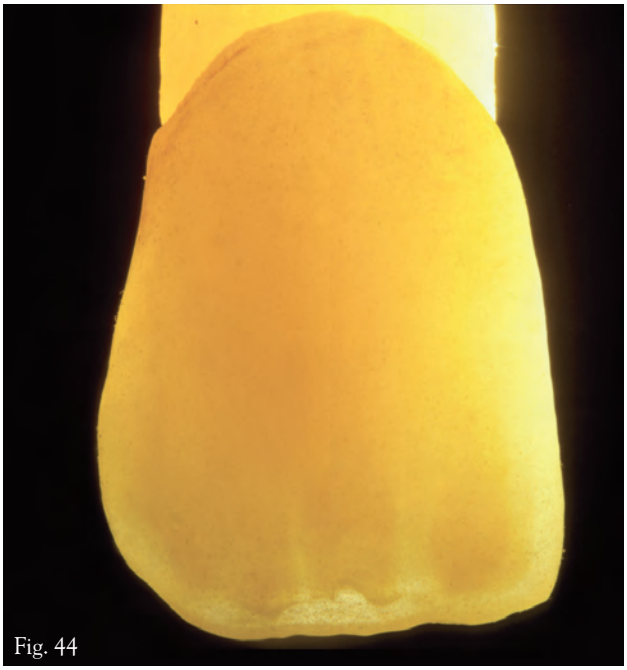

Fig. 44

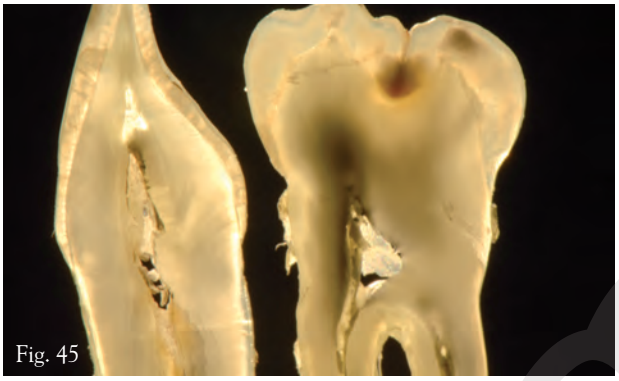

Fig. 45

Fig. 46

Figs. 44 to 46: The Effect Liner does not in any way compromise natural translucency

A thin layer is spread over the structure in zirconium dioxide. Slow increase in final temperature and slow cooling are absolutely indispensable. Structures in zirconium dioxide require more time to absorb oven heat and once the final temperature is reached the heat remains in the zirconium dioxide for a longer period of time. Zirconium dioxide is a poor heat conductor, so it is appropriate to adopt a different type of baking, such as preheating for 8-12 minutes, increasing by 40°C/min, with slow cooling to 600°C.

The Effect Liner does not in any way compromise natural translucency (Figs. 44 to 46). You can only copy what you see. For this reason we analyze nature: teeth in reflected and transmitted light are used as teaching material. The semi-translucency and transmission of light from a cap in zirconium dioxide coated with Vita VM9 are virtually identical to the natural model. Taking nature as an example, it is evident that in this case there are no barriers to the passage of light. The light that reflects on the crown is transmitted to the root, the gingival area and in the papillae.

To be continued in the next issue of Spectrum dialogue.