Dear Readers,

the issue of aesthetics is affecting many areas of our lives. Not only is it a topic of interest in philosophy and various forms of art, it also has an impact e.g. on fashion, architecture and industrial design. In addition, medicine and dentistry also belong to the fields concerned with aesthetics today.

Especially in restorative dentistry, a striving for natural aesthetics can be observed. Ever since the launch of the first tooth-coloured dental filling material 3M™ Addent™ Anterior Restorative by 3M in 1964, dental companies have been involved in the development and optimization of products improving the aesthetic outcome. The goal is an ever increasing approximation to the model of nature and the natural tooth. An example for this pursuit is the invention of the new 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative: Its developers succeeded in making a leading aesthetic material even better.

Offering a combination of clinical case reports and articles, this issue of the 3M™ ESPE™ Espertise™ Magazine provides an overview of the aesthetic possibilities in dentistry today and gives background information on how improvements are achieved. In addition, the reader is guided through the multifaceted world of aesthetics and will learn that this world has much more to offer than commonly known.

Enjoy reading!

Gerhard Kultermann, Editor
3M ESPE, Seefeld, Germany

EDITORIAL

The nature and expressions of beauty.................................................... 2
Translucency and how it influences the perception of beauty................. 3
The glow from within: criteria for natural aesthetics .............................. 4
How to make good things even better.................................................... 6
Layering techniques for aesthetic direct restorations ............................ 8
Dentin adhesive multi-layer restoration ................................................ 10
Restoring a maxillary central incisor...................................................... 11
Multi-layer restoration of two maxillary incisors ................................... 12
Reconstruction of two incisors ............................................................. 14
Restoration of a maxillary lateral incisor................................................. 15
Complex restoration procedure offers beautiful results ......................... 16
Design for reliability and speed ........................................................... 17
A story of beauty and function .......................................................... 18
What do you consider to be aesthetic?

The answer to this question may vary widely and is strongly dependent on the person who will answer. However, it may not only vary from individual to individual, but also from culture to culture. In addition, the age in which the question is asked will also have an impact on the answer: For example, an ancient Greek thinker has had a different perception of what is beautiful than a European knight in the Middle Ages.

Definition and development of aesthetics

Commonly, aesthetics is defined as a philosophical branch that deals with the nature and expression of beauty, art and taste. The term aesthetics derives from the Greek words aesthetikos “sensitive”, and aisthanesthai “to perceive, to feel”.

Aesthetic thoughts have played a decisive role for a long time and have their origins in various ancient societies. The Greek understanding of art and beauty – deeply influenced by the philosophers Plato and Aristotle – had the greatest impact on the development of aesthetics in the Western world. While Plato found that an object’s beauty was defined by proportion, harmony, and unity of its parts, Aristotle named order, symmetry and definiteness as the universal elements of beauty. In Roman times, aesthetics was linked to the cultivation of life (“cultus vitae”), while it was associated with clerical experience in the Middle Ages.

Since then, many different philosophical movements have been observed. A systematic definition of the term aesthetics was given by Alexander Gottlieb Baumgarten in 1750 in his work “Aesthetica”, which focused on individual perception. Other Western thinkers such as Immanuel Kant, Friedrich Schiller and Georg Wilhelm Friedrich Hegel also had an impact on the definition of aesthetics in the 18th to 20th century. In general, beauty was emphasized as the key component of art and aesthetic experience.

In contrast to the Western connotation of the term, the Islamic, Indian, Chinese and Sub-Saharan cultures, for example, have developed their own understanding of aesthetics as well as unique forms and styles of art.

Contemporary aesthetics

Today, aesthetics penetrates almost all areas of human life. It is reflected in art, construction, literature, music, sports and fashion and also affects fields such as geography (e.g. city lighting concepts), medicine (e.g. cosmetic surgery) and dentistry (e.g. restorative dentistry).

Although the understanding of aesthetics is very subjective, some universal values seem to exist. This is true for the perception of nature, for example: One field of contemporary aesthetic theory focuses on the reasons why everyone delights in the beauty of flowers, the landscape or ice crystals. In many different areas of life, like in design and also in dentistry, nature with its unique shapes, colours and effects is a frequently copied model due to its beauty and functionality. In order to achieve natural aesthetics of teeth, two trends are observed in dentistry: The first one is an attempt to imitate the tooth by taking into account the age of the patient, since the appearance of teeth changes over time, just like the landscape undergoes seasonal change. The second trend is the pursuit of a juvenile, successful, white smile for young and old alike.
Translucency and how it influences the perception of beauty

Carina Koppers, 3M ESPE, Seefeld, Germany

Translucency is the phenomenon of light passing through a material diffusely. It describes the intermediate state between transparency, where light enters and leaves a medium almost unobstructed, and opacity, where it is absorbed completely by the material it falls on. It depends on the physical properties of the light, such as its wavelength and energy, as well as on the nature of the material, for example its chemical composition, how light and matter will interact. Transitions between these three visual characteristics are smooth.

The fascination for translucent materials partly originates from the tension of seeing something but only vaguely. While a veil reveals a hint of what lies behind, at the same time it does not disclose its secret completely and thus renders it the more interesting. Another reason why we perceive translucent materials as beautiful is the way they capture rays of light within themselves.

Aesthetics of natural teeth

Our judgement on the aesthetics of teeth is closely connected to this visual effect. A healthy natural tooth is partly permeable to light. The enamel is more transparent than the dentine. Some light shines through the tooth substance and gives it a depth effect, while the gingiva, illuminated by refracted light that enters into the tooth root, also appears in a vital colour. The total effect of this interaction with light is the desired red and white aesthetics. Light reflections on the surface also add to the impression that the tooth is beautiful.

How 3M ESPE facilitates lifelike restorations

The highest aim of restorative dentistry is therefore to come as close to this ideal as possible. To imitate the natural appearance of a vital tooth, the properties of the materials used for a restoration must be similar to those of dentine and enamel when exposed to light.

In cases of root canal filling, insufficient residual tooth structure can be supported by a post. Thus the coronal restoration is stabilized. While metal posts were frequently used before, posts made of glass fibers embedded into a composite resin matrix, such as RelyX Fiber Posts, have recently gained popularity. Several reasons have influenced this shift, one major argument in favour of such materials being their superior aesthetics. An opaque, dark metal post is visible through enamel and full ceramic restorations. This distracting shadow within the tooth gives it a lifeless appearance. Much in contrast, the RelyX Fiber Post exhibits optical features similar to that of natural dentine. Light is reflected on the surface and also scattered within, the restored tooth appears as shiny and bright as its natural model.

The natural translucency of RelyX Fiber Post is of particular importance for anterior restorations. To ensure an accurate fit, the post is already available in three sizes. An additional size – Size 0 – with an even smaller diameter will be launched in 2010.
The glow from within: criteria for natural aesthetics

André Rumphorst, 3M ESPE, Seefeld, Germany

One important aim in direct and indirect restorative therapy is the realization of natural aesthetics. Next to the best possible anatomical integrity, aesthetics are decisively influenced by the optical properties of the restoration and accordingly by the perception of colour.

Parameters that influence the appearance of a tooth

The main criteria that must be considered to achieve the desired result can be outlined by six parameters: hue, value, chroma (or saturation or colourfulness, depending on the colour model), opalescence, opacity and fluorescence. These factors influence each other depending on the structure of the tooth and also vary within a small space. Enamel and dentine feature fine inhomogeneities, resulting in further diffraction of light, which gives each tooth an individual and unique look. Via these complex dynamics the natural tooth receives its vital appearance.

Chroma, value, hue

Chroma, value and hue have been optimized and continually improved from an early stage, especially in restorative materials such as 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative. Every single tooth shade, e.g. A3D, corresponds to a precisely defined point in the three-dimensional HSV colour model. H stands for hue, S for saturation and V for value. These three criteria can be specifically controlled via pigments.

Opalescence and opacity

Opalescence and opacity are mainly influenced by the size of the fillers and the overall structural composition of a material. Both characteristics cause light diffusion. If the particles that effect this diffusion are smaller than the wavelength, opalescence is the result, the opposite case is called opacity. By means of adjusting the particle size into the nanometer area, virtually any desired degree of opalescence and opacity can be achieved. These optical characteristics are supported ideally by the patented nanotechnology applied, e.g. in 3M™ ESPE™ Filtek™ Supreme XT Universal Restorative or 3M™ ESPE™ Protemp™ 4 Temporization Material.

Increasing interest in fluorescence

Fluorescence is a topic that has been dealt with more intensely only in recent years. It describes the property of matter to absorb light and reflect it again with an increased, less energetic wavelength. This effect is striking in cases were invisible ultraviolet light (350-365 nm) is absorbed and light in the visible region (~400 nm) is emitted. A well-known example of this can be observed in discotheques, where clothes and beverages featuring a suitable fluorescent colorant begin to glow under the so-called black light. These colorants may be certain minerals or optical brighteners often added to laundry detergents.

In medicine fluorescent substances can be used as markers, e.g. to distinguish different cellular components under a microscope. Some sea animals also exhibit fluorescence or phosphorescence, usually to attract a partner – or prey. In contrast to phosphorescence, which may last for hours after the material has been radiated, fluorescent material immediately re-emits the radiation it absorbs and then ceases to glow.
Autofluorescence of natural teeth

Natural teeth possess autofluorescence, i.e. they show this property without any kind of preparation. Dentine, more specifically the hydroxyapatite minerals and organic matrix, exhibits higher fluorescence than enamel. Therefore the tooth appears to glow from the inside when exposed to light. Teeth fluoresce blue-white. It is desired to simulate this effect in restorative materials, which can be achieved e.g. by specific layering techniques. Materials with different optical properties are combined to make the restoration as lifelike as possible. A tooth is constructed layer by layer, according to the appearance of the natural teeth.

Fluorescence in restorative materials

The optical properties of restorative materials, such as 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative, and temporization materials like 3M™ ESPE™ Protemp™ 4 Temporization Material are defined by the interaction of the filler particles and the resin matrix. For the targeted adjustment of the fluorescent properties, a very small amount of a specific organic dye pigment is added and homogenously distributed in the formulation. Thanks to the nanofiller particles, the originated fluorescence light is scattered through the material undisturbed by larger particles, which results in a lifelike vivid fluorescence and natural aesthetics of the restoration.
Interview with Dr. Bradley D. Craig, Senior Product Development Specialist at 3M ESPE Dental Products Division, St. Paul, Minnesota.

Dr. Craig, you have been involved in the development of a number of successful products, including 3M™ ESPE™ Ketac™ N100 Light-Curing Nano-Ionomer-Restorative, 3M™ ESPE™ Filtek™ Supreme XT Flowable Restorative, 3M™ ESPE™ Filtek™ Supreme XT Universal Restorative, 3M™ ESPE™ Adper™ Scotchbond™ 1 XT Adhesive and 3M™ ESPE™ Filtek™ Silorane Low Shrink Posterior Restorative. Many of them are based on nanotechnology. What are the special features of nanocomposites?

Composites consist of an organic resin matrix and an inorganic filler system. Both components can be altered to optimize the material’s properties. For example, the size of the fillers is critical for the physical properties of a composite. Hybrid composites possess macro fillers as well as micro fillers. Therefore they exhibit high strength. The matrix of microfills solely contains micro fillers, which enables an extraordinary initial gloss and polish retention, but gives much poorer mechanical strengths than the hybrid materials.

Nanocomposites present a unique blend of the physical properties of hybrids and the aesthetic qualities of microfills. This combination of benefits is achieved by a novel approach: Nanometre-sized particles are added to the resin matrix as individual particles and also in clusters, or agglomerates or aggregates. These partially fused fillers are designed to break during the wear process, thus only relatively small particles are lost, not the whole cluster. Therefore the use of nanoclusters results in a very good polish retention, since the surface of the restoration remains smooth in comparison to a conventional hybrid or nanohybrid material. In contrast, when the micron-sized particles of hybrids or nanohybrids break off, they leave comparatively large craters in the surface of the restoration.

Filtek Supreme XTE Universal Restorative, another product you have contributed to, has recently been launched. It builds on the properties of its predecessor, Filtek Supreme XT restorative. Could you please illustrate these properties in short?

Besides its high compressive, flexural and diametral strength and fracture toughness needed for posterior indications, the material exhibits excellent aesthetic properties required for single and multi-layer anterior restorations. Filtek Supreme XTE offers 36 shades and 4 opacity levels, with the shades more tailored to users’ needs, which enables a fine adjustment and shade matching to the natural tooth. Another striking feature is its improved polish retention, facilitated by our patented nanotechnology mentioned before. The difference in particle size, compared to hybrids, allows the restorative material to retain a high percentage of initial polish, even after time in the oral environment. This polish retention is exhibited after even 6,000 toothbrush strokes in our testing and is truly a differentiator that is clearly visible compared with competitive materials and technologies. Finally, its sculptability and non-sticky consistency due to the high filler loading make its handling excellent.

How is this material manufactured?

The fillers used for Filtek Supreme XTE restorative are a combination of silica/zirconia nanoclusters, 20 nm nanoparticle silica and approximately 10 nm nanoparticle zirconia in predefined ratios. The individual spherical particles undergo a silane treatment, those intended for agglomerates/aggregates are first clustered with a zirconium compound. Afterwards, the nanoclusters are also treated with silane. The silanization process provides compatibility and chemical bonding with the organic resin. Finally, individual nanoparticles and nanoclusters are embedded in the resin matrix.

Why was the well-proven material Filtek Supreme XT restorative optimized? Which improvements were made?
Our objective was to make a very successful product even better, especially in terms of aesthetics, and to create a next-generation nanocomposite. For instance, we improved the long-term polish retention for dentin, body and enamel shades even further. The nanoclusters used for 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative wear more uniformly with the surrounding resin matrix during abrasion, thus the surface of the restoration remains particularly smooth. Furthermore, the handling of translucent shades was improved and they were made radiopaque. Capsule delivery of translucent shades is now possible, which was not the case with 3M™ ESPE™ Filtek™ Supreme XT Universal Restorative. The overall shade offering and system were also changed: Filtek Supreme XTE offers yet more single-shade and multiple shade solutions than its predecessor and the syringes and capsule bottles are colour-coded by opacity, which facilitates shade selection and increases the ease of use of the system. In addition, we made the material fluorescent, thus restorations appear even more natural and lifelike.

How did you proceed during the development process?

The development of Filtek Supreme XTE restorative took several years. Dozens of people from diverse areas of expertise were involved, from laboratory staff to marketing experts. Experimentation and development work were followed by a phase of extensive testing and evaluation, until we arrived at the final formulation of the material. In spring 2010, the process was completed with the launch of the new product.

Were there obstacles you had to overcome?

There are always difficulties in the process of invention. An example of a challenge was when we realized that our translucent shades needed to exhibit both opalescence and radiopacity, much like natural enamel. We literally had to invent a new class of filler with both features, while still delivering on all of the other requirements.

However, the greatest single challenge was to enhance the existing product while maintaining the already high level of performance of Filtek Supreme XT restorative. If one property of the material is changed, this also influences other features. After all, we did not want to give up anything that was already included in the successful predecessor. In the end, we succeeded in preserving the positive qualities already present, while at the same time reaching our goal to optimize specific features. The whole development process was very labour intensive and could only be realized with a great team. It is characteristic of 3M ESPE that they give these processes time and invest in further development to ensure extraordinary results for the clinician and patient.

Dr. Craig, thank your for the interview.
Layering techniques for aesthetic direct restorations

Angelo Putignano, Ancona, Italy

To create highly aesthetic restorations in the posterior and especially in the anterior region, their appearance should be as close to that of natural teeth as possible. Therefore, the anatomical layers of the tooth should be reconstructed in the according layer thickness and with the same physical properties. The shades of the composite used as a restorative material have a crucial influence on how the filling will blend in. The tables below suggest shade recipes for the single-layer, two-layer and the multi-layer technique with Filtek Supreme XTE Universal Restorative. They are based on practical experiences gained in a testing phase with this new material before launch. In the following the application of these tables is illustrated.

Single-layer technique

The application of only one shade is a timesaving option for restorations in the posterior region. With a high-quality composite, sufficient aesthetics are obtained, as can be seen in the following example. Filtek Supreme XTE restorative enables good results even in the anterior region. Still, this technique is not advisable for front tooth restorations.

Two-layer technique

In the posterior region, the two-layer technique offers very convincing results. In the case below, layers of two different shades have been applied into the cavity, according to the structure of the tooth substance. Individualization is achieved with little drops of brown tint. For the challenging anterior region, the two-layer technique provides suf-
efficient results, yet leaves something to be desired in terms of perfect aesthetics.

Multi-layer technique

When aesthetic standards are particularly high, the multi-layer technique provides excellent results and is therefore the method of choice in the anterior region. To rebuild an incisor, as illustrated below, four different composite shades are applied. The palatine wall is remodelled on a silicon key with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in an enamel shade and after this attached to the tooth. Next the dentine is recreated on this substructure by layers in an according dentine shade. Afterwards, the dentine part is overlaid with a body shade. Individualizations can be placed on the incisal edge, which are finalized with a clear shade. Vestibular layers of the enamel shade used for the palatine wall before completing the restoration. The schema illustrates the proceeding.

The two-layer technique provides satisfactory results in the posterior region.

The initial situation shows an insufficient, discoloured filling.

Initial situation, both incisors are fractured.

The palatine wall is remodelled and applied by means of a silicon key.

The labial wall is created by an enamel shade.

The incisal edge is individualized.

The final result after polishing.

The tooth is rebuilt by a dentine shade and a body shade.


The recipes simplify the shade selection for direct restorations. Thus, they reduce the work load of the dentist, while enabling beautiful results with all three layering techniques.
Dentin adhesive multi-layer restoration

Stefan Schwöbel, Germany

Figure 1: The patient presented with an insufficient composite and an amalgam filling. A complex restorative procedure was necessary to restore the teeth.

Figure 2: After caries excavation and a check with a caries detector, a dry working field is achieved by placing a rubber dam.

Figure 3: The restoration of tooth 47 is done with a multi-layer technique and begins with the shaping of the basal area. A layer of 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in the shade A3B is applied and light cured for 20 seconds. At the mesial approximal cavity, a foil matrix is placed with a wooden wedge.

Figure 4: In the next step, the mesial area is layered in the shade A2E and light cured.

Figure 5: Subsequently, the matrix is removed and the mesiobuccal as well as the distolingual cusp are layered in the enamel shade A2E and polymerized. At this stage, it is useful to copy the natural shape of a cusp.

Figure 6: Now, the mesiolingual and distobuccal cusps are layered based on the cusps modeled before. An anatomical shape of the modelation is desired.

Figure 7: After having finished the occlusal part, the distal area is modeled with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in the enamel shade A2E without using a matrix.

Figure 8: To finish the layered restoration, the smooth surfaces are treated with 3M™ ESPE™ Sof-Lex™ Contouring & Polishing Discs. For the occlusal relief, the concave shaped polishing brush OptiShine™ (KerrHawe) is used.

Figures 9 and 10: The finished restorations excel through their adaptation to the natural tooth structure and their outstanding gloss.
Restoring a maxillary central incisor

Gabriel Krastl, Switzerland

Figure 1: Initial situation with a crown-root fracture in tooth 21. The determined shade according to the VITAPAN® classical A1-D4 shade guide matches A2. Since the edges of the defect lie in the subgingival area, the tooth has to be exposed using electrosurgery.

Figure 2: The rubber dam is secured with an individualized anterior tooth clamp. The matrix band is fixed at the adjacent tooth with 3M™ ESPE™ Filtek™ Supreme XT Flowable Restorative, it ideally reproduces the approximal contour of the tooth.

Figure 3: After having finished the approximal and palatal wall with 3M™ ESPE™ Filtek™ Supreme XT Flowable Restorative A2 shade and 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative A1E shade, the cervical part of the dentin core is built up with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in the shade A3.5D.

Figure 4: Taking into account the mamelon structures of the incisor, the dentin core is completed with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative A3D. 3M™ ESPE™ Filtek™ Supreme XT Flowable Restorative XW is used to simulate the whitish opacities which are part of the natural tooth.

Figure 5: If the correct layering technique is used, only little space is left to cover the labial part with enamel mass (3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative A1E).

Figure 6: If the tooth anatomy is built up correctly, the finishing and polishing steps are reduced to a minimum.

Figure 7: After removal of the rubber dam, the restoration is visible only because of the colour difference to the dry tooth structure.

Figure 8: In the palatal area, the tooth shape is correctly restored as well.

Figure 9: One week after the treatment, no difference between the restoration and the meanwhile rehydrated tooth is visible.

Figure 10: The comparison of the two central incisors shows that the restoration is indistinguishable from the natural tooth structure.
Multi-layer restoration of two maxillary incisors

Antonella Leone, Italy

Figure 1: Initial situation: The maxillary central incisors are affected by discolouration. This is clearly visible from a labial ...

Figure 2: ... as well as a palatal view.

Figure 3: The initial radiograph shows that the root canal treatments are still satisfactory after 15 years.

Figure 4: Prior to the restoration of the teeth with the 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative, an internal bleaching treatment is performed with the walking bleach technique using Opalescence® Endo (Ultradent). For this purpose, the gutta-percha in the root canal is removed as far as 2 mm below the gingival margin. The result of the treatment is clearly visible.

Figure 5: After removal of the old fillings, the incisors are prepared under rubber dam.

Figure 6: Palatal view of the prepared teeth.

Figures 7 and 8: Before the use of 3M™ ESPE™ Adper™ Scotchbond™ Multi-Purpose Adhesive, the phosphoric etchant is applied.
Figure 9: Using a silicone matrix that has been prepared in advance as an aid, the first layer of 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in the enamel shade A2 is applied.

Figure 10: After built-up of the interproximal walls with A2E, a layer of A3B is adapted.

Figure 11: For the following layer, the shade A3D is selected.

Figure 12: The incisal edges are designed by adding white intensive and opalescent tint.

Figure 13: Afterwards, a layer of 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative in the shade A3B is applied …

Figure 14: … and the thickness of the restoration is checked.

Figure 15: For the final layer, the shade A2E is used.

Figure 16: After polishing with small rubbers, alumina polishing paste and fine diamond discs, the restoration is highly aesthetic.

Figure 17: The final result three months after the treatment is impressive.
Reconstruction of two incisors

Stephane Browet, Belgium

Figure 1: Basic clinical situation with massive loss of hard tissue at teeth 11 and 12.

Figure 2: Clinical situation after beveling and etching with acid.

Figure 3: Modeling of the enamel margins and the mamelons with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative.

Figure 4: Reconstruction of the central dentin.

Figure 5: Final restoration of tooth 11 before finishing and polishing.

Figure 6: Reconstruction of tooth 12 using a Bioclear matrix.

Figure 7: Highly satisfying final result.
Restoration of a maxillary lateral incisor

Rafał Mędzin, Poland

Figure 1: The preoperative situation shows a defective crown on tooth 22 and an insufficient Class IV restoration on tooth 12.

Figure 2: The crown on tooth 22 is removed.

Figure 3: The preparation is revised.

Figure 4: A provisional crown made of 3M™ ESPE™ Protemp™ 4 Temporization Material is placed.

Figure 5: Removal of the old Class IV restoration on tooth 12.

Figure 6: Tooth 12 from a palatal view.

Figure 7: A silicone template is produced for the restoration of tooth 12 with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative.

Figure 8: The basis is restored with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative. To achieve natural aesthetics, a layer of composite material in the shade YT and a drop of brown tint are added.

Figure 9: A 3M™ ESPE™ Lava™ Zirconia crown is placed on tooth 22. The outcome is impressive.

Figure 10: Palatal view of the final result.

Figure 11: The natural appearance of the restorations at a recall after two months.
The patient presented in the dental practice for a complex restorative treatment. The treatment plan was to place 3M™ ESPE™ Lava™ Zirconia crowns on teeth 12 to 23 and bridges in regions 13 to 16 as well as 24 to 26. Lava Zirconia was chosen as a framework material because reproducibly good results are achievable with respect to aesthetics and marginal quality.

Fig. 1: The initial situation.
Fig. 2: Due to different defects, teeth 16 to 26 had to be restored.
Fig. 3: The teeth after preparation.
Fig. 4: The milled and sintered 3M™ ESPE™ Lava™ Zirconia frameworks were fitted on the model.
Fig. 5: The 3M™ ESPE™ Lava™ Zirconia structures showed a high marginal precision and accurate fit.
Fig. 6: After veneering with 3M™ ESPE™ Lava™ Ceram Overlay Porcelain and an initial firing, the restorations were tried in.
Fig. 7: A bite registration was taken.
Fig. 8: The restorations after finishing.
Fig. 9: The fit of the crowns and bridges was checked on the model.
Fig. 10: Directly after cementation, a beautiful result with excellent red and white aesthetics was achieved.
Fig. 11: The patient was thrilled by the natural appearance of the 3M™ ESPE™ Lava™ Zirconia crowns and bridges.
In 1953, the company ESPE Dental launched its first local anaesthetic solution for dental applications. The expertise of the enterprise in this field, which is built on more than 50 years of experience, was leveraged for the development of effective anaesthetics. These include Mepivastesine and the 3M™ ESPE™ Ubistesin™ product family, which has been produced since 1985 and is still highly successful today. In 1997, the company opened a new local anaesthetics plant in Seefeld, Germany. In order to optimize the production process and increase the production volume, the local anaesthetics focused factory at 3M ESPE in Seefeld has just installed a new filling line which integrates the most advanced technologies. The new machinery will allow a significant increase of the production capacities on a long-term basis and will require less effort for maintenance and service.

In a tough schedule of less than four months, the old filling line was dismantled and removed, the premises were renovated — a new roof, walls and a protective floor were incorporated — and the new machinery was integrated as well as put into operation. The project, including the challenging installation of electrical and mechanical parts, was carried out in close collaboration with the machine supplier. Before the production was started again in October 2009, the machine had to pass extensive validation and qualification tests.

Elaborate design

The new plant is composed of a washing machine which is responsible for purification of the cartridges in a special procedure as well as siliconization using a new spraying technique. In addition, the silicon layer on the inner wall of the cartridges is burnt onto the surface in this machine with highly purified air and heat. The second part of the plant is the new filling line. Here, the rubber stopper is placed at the bottom of the cartridge and the cartridges are filled in two steps by a laser-controlled process as well as cramped. Afterwards, they are forwarded to the sterilization trays and heat-steam sterilized.

Since a sterile environment is needed for the filling of the cartridges, the design of the machine has to meet specific standards. This includes a closed design of the filling system which eliminates the need for external intervention. For this purpose, the different elements of the line are precisely aligned and adjusted to each other as well as controlled by an automatic system. The key is a combination of advanced technology including full automation and control by computerized systems with a compact and clear structure of the machinery.

High-tech plus design

The combination of a smart design and the latest technology has created a highly productive and reliable new production line. Since the new machine will allow a considerable rise of the production capacities within the next years, and meets the highest production standards, it makes sure that 3M ESPE is prepared for the future.
Design is an element of ever increasing importance in the process of product development. However, styling of products and devices not only pursues the goal of beautifying the external appearance: Contemporary industrial design combines aesthetic and functional aspects in order to satisfy collective as well as individual needs.

According to the Industrial Designers Society of America, “Industrial Design is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer”. In order to optimize aesthetics and functionality of a product, the designer has to bring together art, science and technology. To gain access to the relevant technological knowledge and experience, a collaboration with experts of the specific fields is often necessary.

Design at 3M

At 3M, the issue of design plays a major role for the development of innovative products as well as for the optimization of existing solutions. 3M has realized decades ago that an elaborate design has more to offer than beauty and can have a strong impact on a product’s performance and practicality. Therefore, the enterprise closely collaborates with designers for special projects.

Fruitful partnerships

Several years ago, for example, 3M initiated a partnership with the Italian design company Pininfarina Extra. As an international designer of cars for enterprises such as Ferrari, Maserati and Jaguar, its parent company Pininfarina has become highly popular in the automotive industry. Pininfarina Extra was founded in 1986 and focuses on sectors other than car manufacturing, like architecture, sports and technology. The enterprise is well-known for its elegant, essential style and the elimination of superfluous details to maintain only what is necessary for convenient, safe operation. The aim of partnering with Pininfarina and other experts in industrial design is to provide the customer with an additional value regarding ergonomics and usability of the designed objects.

The first project resulting from the cooperation between the Italian design expert Pininfarina and 3M was the launch of a complete product line of video projectors in 2003. Further projects realized by the two companies to provide users with beautiful objects utilized in everyday life include the development of an air purifier as well as dispensers for 3M™ Post-it® Z-Notes and 3M™ Scotch™ Magic™ Tape. The dispensers have an appealing, sleek design and are eye-catchers on every desk. In addition, they offer practical benefits, such as simplified one-handed dispensing with the 3M™ Post-it® Z-Note Dispenser. The 3M™ Filtrete™ Ultra Slim Room Air Purifier is intuitive in use and, due to a sensual shape, also unique in its appearance. All devices exhibit advanced technology and technical features as well as an ergonomic, elegant and sober form.

Award winners

In order to receive professional and objective feedback on the developed products and ensure high quality, 3M participates in various design competitions. Here, the attractive form and reliable function of the solutions is often confirmed: The Filtrete Ultra Slim Room Air Purifier has been awarded for its particularly successful, creative design details in the category product design of the red dot design award 2008. In this internationally renowned competition, the assessment criteria include e.g. the degree of innovation of a product, its functionality, ergonomics, and clarity of function.

Sonja von Eichmann and Carina Koppers, 3M ESPE, Seefeld, Germany
The 3M™ Speedglas™ 9100 Auto-Darkening Welding Shield, which was designed by the top-ranking, international design company Ergonomidesign in collaboration with medical experts, is an award-winning product as well. It has received the Best of the Best designation of the red dot design award in 2009 as well as the iF gold award 2009 in the category industry/trade. As a design competition allows objectifying a number of usually very subjective decisions, doing well in a competition often is a first sign for the success of the awarded product.

Design at 3M ESPE

At 3M ESPE, usability and design are also high on the priority list for product development. The 3M™ ESPE™ Pentamix™ 3 Automatic Mixing Unit, the 3M™ ESPE™ Elipar™ S10 LED Curing Light and the new 3M™ ESPE™ Lava™ Chairside Oral Scanner C.O.S. are just a few examples where a high product quality goes hand-in-hand with an appealing, award-winning form. The Pentamix 3 unit has won the red dot award for product design in 2009, and is also nominated for the 2010 Design Award of the Federal Republic of Germany. Besides its unrivalled speed in automatically mixing impression materials, also putties, it is the smallest device available saving valuable counter space.

The curing device Elipar S10 for the polymerization of dental materials successfully overcomes the dichotomy between appearance and performance. Made of stainless steel and produced by a technique termed hydroforming, it offers the user a visual pleasure, ergonomic handling, robustness and durability. These features are combined with a puristic style and an elimination of superfluous details for intuitive operation.

Last but not least, the Lava C.O.S., honoured with a Bronze 2008 International Design Excellence Award (IDEA) in the Medical & Scientific Products category, successfully combines aesthetics with advanced technology. The expert jury of IDEA assessed the products by taking into account criteria such as design innovation, benefit to the user and the society, ecological responsibility, appropriate aesthetics and appeal as well as usability.

More than just external attraction

During the past decades, industrial design has evolved to become an indispensable element in product development. For many users, the appearance of a device or tool as well as product packaging has a strong impact on their decision to use it. But external beauty is not the only factor to be respected: The sophisticated combination of form and function is the ultimate key to a product’s success.

The 3M™ ESPE™ Pentamix™ 3 Automatic Mixing Unit has the smallest footprint on the market.

The 3M™ ESPE™ Elipar™ S10 LED Curing Light is made of stainless steel.

Winner of IDEA 2008: The 3M™ ESPE™ Lava™ Chairside Oral Scanner C.O.S.
## Calendar of Events 2010

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>07.05.2010</td>
<td>WID Wiener Internationale Dentalausstellung</td>
<td>Vienna</td>
<td><a href="http://www.wid-dental.at">www.wid-dental.at</a></td>
</tr>
<tr>
<td>08.05.2010</td>
<td></td>
<td></td>
<td>Österreischer Dentalverband</td>
</tr>
<tr>
<td>12.05.2010</td>
<td>32nd Asia Pacific Dental Congress 2010</td>
<td>Colombo</td>
<td><a href="http://www.apdc2010.com">www.apdc2010.com</a></td>
</tr>
<tr>
<td>15.05.2010</td>
<td></td>
<td></td>
<td>Sri Lanka Dental Association</td>
</tr>
<tr>
<td>13.05.2010</td>
<td>2010 Annual Spring Meeting</td>
<td>Toronto</td>
<td><a href="http://www.oda.on.ca">www.oda.on.ca</a></td>
</tr>
<tr>
<td>27.05.2010</td>
<td>Salón Dental Chile</td>
<td>Santiago de Chile</td>
<td><a href="http://www.salondentalchile.cl">www.salondentalchile.cl</a></td>
</tr>
<tr>
<td>18.06.2010</td>
<td>1st Hong Kong International Dental Expo And Symposium</td>
<td>Hong Kong</td>
<td><a href="http://www.hkideas.org">www.hkideas.org</a></td>
</tr>
<tr>
<td>25.06.2010</td>
<td>SIDEX 2010</td>
<td>Seoul</td>
<td><a href="http://www.sidex.or.kr">www.sidex.or.kr</a></td>
</tr>
<tr>
<td>07.08.2010</td>
<td></td>
<td></td>
<td>CACID</td>
</tr>
<tr>
<td>02.09.2010</td>
<td>2010 FDI Annual World Dental Congress</td>
<td>Salvador de Bahia</td>
<td><a href="http://www.fdiworldental.org">www.fdiworldental.org</a></td>
</tr>
<tr>
<td>23.09.2010</td>
<td>CEBE 2010</td>
<td>Poznan</td>
<td><a href="http://www.cebe.pl">www.cebe.pl</a></td>
</tr>
<tr>
<td>07.10.2010</td>
<td>38th International Exponential</td>
<td>Rome</td>
<td><a href="http://www.expodental.it">www.expodental.it</a></td>
</tr>
<tr>
<td>09.10.2010</td>
<td></td>
<td></td>
<td>Promunidi S.r.l.</td>
</tr>
<tr>
<td>09.10.2010</td>
<td>ADA Annual Session</td>
<td>Orlando</td>
<td><a href="http://www.ada.org">www.ada.org</a></td>
</tr>
<tr>
<td>10.12.2010</td>
<td></td>
<td></td>
<td>ADA</td>
</tr>
<tr>
<td>14.10.2010</td>
<td>BDTA Dental Showcase 2010</td>
<td>London</td>
<td><a href="http://www.dentalshowcase.com">www.dentalshowcase.com</a></td>
</tr>
<tr>
<td>16.10.2010</td>
<td></td>
<td></td>
<td>BDTA</td>
</tr>
<tr>
<td>18.11.2010</td>
<td>Swedental 2010</td>
<td>Stockholm</td>
<td><a href="http://www.swedental.org">www.swedental.org</a></td>
</tr>
<tr>
<td>20.11.2010</td>
<td></td>
<td></td>
<td>Stockholmsmässan</td>
</tr>
<tr>
<td>23.11.2010</td>
<td>ADF 2010 Conference and Trade Exhibition</td>
<td>Paris</td>
<td><a href="http://www.adfcongres.com">www.adfcongres.com</a></td>
</tr>
<tr>
<td>27.11.2010</td>
<td></td>
<td></td>
<td>ADF</td>
</tr>
<tr>
<td>01.12.2010</td>
<td></td>
<td></td>
<td>Greater New York Dental Meeting</td>
</tr>
</tbody>
</table>

## EDITORIAL Information

**Editor:**

Gerhard Kultermann

**Editorial team:**

Roland Bosch
Tomas Chytil
Sonja von Eichmann
Pinar Kahraman
Oliver Kappler
Dieter Klasmeier
Carina Koppers
André Rumphorst

**Production:**

[www.eberl.de](http://www.eberl.de) · Immenstadt/Germany

**Design and typesetting:**

Comcord GmbH · Düsseldorf/Germany

We accept no liability for unsolicited manuscripts or photographs.

**Court of Jurisdiction:** Munich

**Published by:**

3M ESPE AG

ESPE Platz · 82229 Seefeld

E-Mail: info3mespe@mmm.com

Internet: [www.3mespe.com](http://www.3mespe.com)

© 3M ESPE AG 2010. All rights reserved.