kuraray

Noritake

BOND

NEWSLETTER FOR PROFESSIONALS IN DENTISTRY

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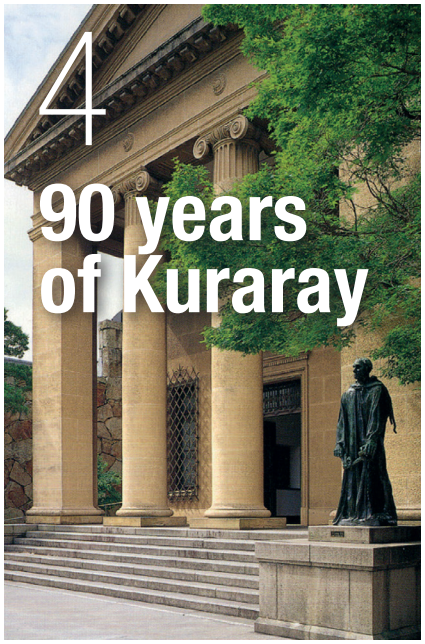
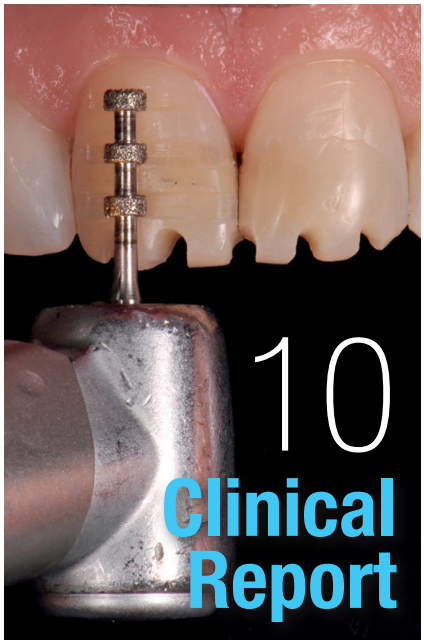




Contents

Decades
of leading dental adhesive technology

In 1978, a long time ago, back when adhesive dentistry was still in its infancy, our company launched one of the very first reliable dentine-enamel bonding agents: CLEARFIL BOND F.

Following the launch of this outstandingly innovative adhesive system, we surprised the world with PANAVIA™, a name synonymous with maximum adhesion. This product led the way to treatment options for more adhesive and fewer retentive bridges. Thanks to PANAVIA™, many permanent dental materials can be applied by means of a luting agent. Our adhesive monomer MDP was at the heart of the success of PANAVIA™.

MDP was invented 35 years ago. And to this day, MDP remains the leading functional monomer for reliable adhesion to hydroxyapatite and metals. Ever since its introduction, this MDP monomer has been applied in many Kuraray Noritake products. MDP monomer is a unique functional monomer with a proven track record which can also boast of its frequent appearance in dentistry literature.

Following the launch of CLEARFIL™ SE BOND more than 15 years ago, the self-etch concept was presented to the world. Once more, the exceptionally pure MDP monomer contributed to the success of CLEARFIL™ SE BOND. Meanwhile, CLEARFIL™ SE BOND has developed into one of the most researched bonding agents worldwide, with a clinically proven track record in the literature of well over a decade. In this newsletter, you will find more information about a 13 year clinical research project by the University of Leuven / Biomat into CLEARFIL™ SE BOND.

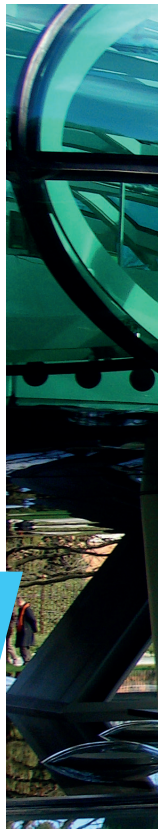
You will also find extensive information about our new luting agent – PANAVIA™ V5. Alongside a number of bonding agents, our company also manufactures a range of highly sophisticated restorative materials, indirect multi-layered zirconia materials and veneering ceramics.

Kuraray Noritake Dental is all about dentistry. And Kuraray Inc. is more than dentistry; we are a major player in the global chemical industry. Many of our products can be found in everyday life, ranging from anti-reflective coatings for computer screens and security film glass to components for cosmetics.

We invite you to read our newsletter, where you will find more about the work of Kuraray Noritake Dental. And you are also invited to contact us to find out what we can do for dentistry in general, and what we could mean for you in particular.

Joost Nederkoorn - Head European Marketing.

Contact
centralmarketing@kuraray.com



Bolle Exhibition Centre, Grappa Nardini, Bassano del Grappa, Italy

Glass types: 2,000 units of insulation glazing and float glass with Trosifol® film, 45 mm thickness per glazing unit.

90 years of Kuraray
a glimpse of the history

Kuraray will be celebrating its 90th anniversary this year. We take the opportunity of this occasion to offer you a glimpse of the history of Kuraray from a new perspective. The name Kuraray represents more than 8,300 employees and an annual turnover of approximately 3.7 billion euros. Kuraray was founded in Kurashiki, Japan, in June 1926, by Magosaburo Ohara. Kuraray began with the domestic production of Rayon, a synthetically produced cellulose fibre referred to as artificial silk, a new and innovative product at the time.

The founder of Kuraray Magosaburo Ohara

The name KURARAY is derived from the location: **Kura**shiki and the product manufactured: **Ray**on.

The development of this branch of production developed very quickly in Japan, with many other major manufacturers establishing themselves during this period. Whereas others recruited their technicians and experts from elsewhere, Kuraray established the Kyoko Research Laboratory, which was managed by the University of Kyoto to generate expertise and support for the development of the required technologies.

Ohara also committed himself to cultural and social projects. The building of an art gallery and the financing of an orphanage represent only two of his many projects in Kurashiki. The Ohara Museum of Art was the first private museum of Western art in Japan.

Ohara considered the dreadful conditions in which employees commonly worked and lived at the time to be unacceptable; he was not a profit-driven employer, and attempted to solve such issues. He ensured that decent accommodation,

fitness facilities and nursery schools were built to provide young employees, or families who had left their homes to work for Kuraray, with everything they needed for education and a healthy and culturally rich lifestyle.

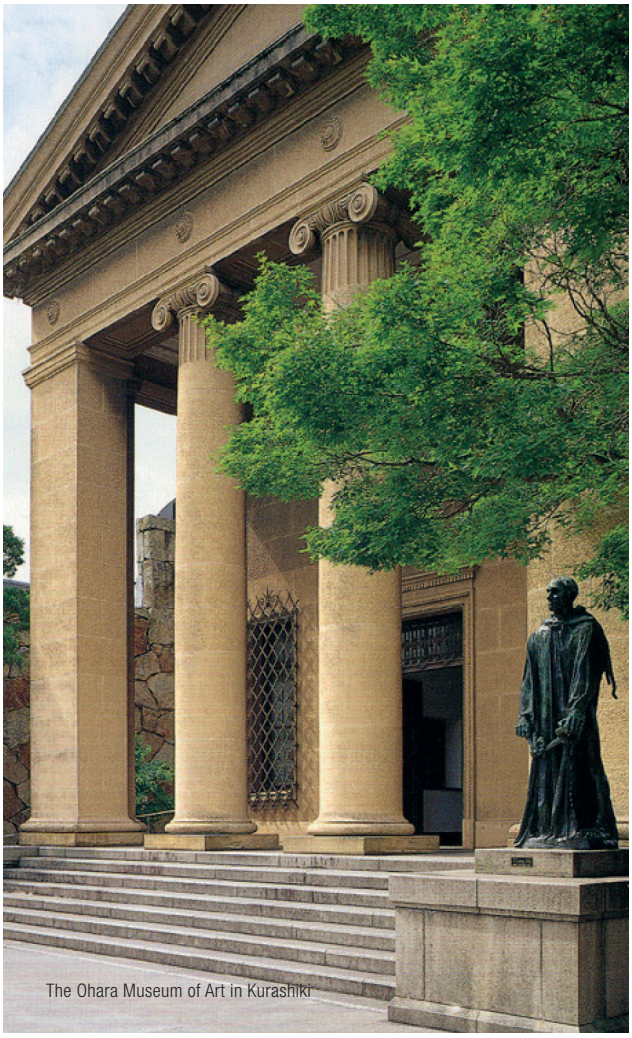
One of the largest general hospitals in the west of Japan, the Kurashiki Central Hospital, was originally founded by Kuraray to promote the well-being of employees and their families. It is still considered to be one of the most famous hospitals in Japan.

With the production of Kuralon in 1950, developed from the in-house manufactured products PVA and vinyl acetate, Kuraray expanded to become the specialist chemical company it is today.

Always intent on making a contribution to the good of society, Kuraray addressed the subject of environmental protection very early on. The visionary Ohara was aware of the seriousness of environmental pollution, and made great efforts to prevent it.

Internationally too, Kuraray has remained aware of its social responsibilities. After the war, a production facility was opened in China which helped to improve the poor post-war living conditions of the Chinese population.

Today, Kuraray is a leading global manufacturer of the specialist chemicals used in many aspects of daily life. Kuraray has always viewed its employees as its most important asset, and continues to do so to this day.



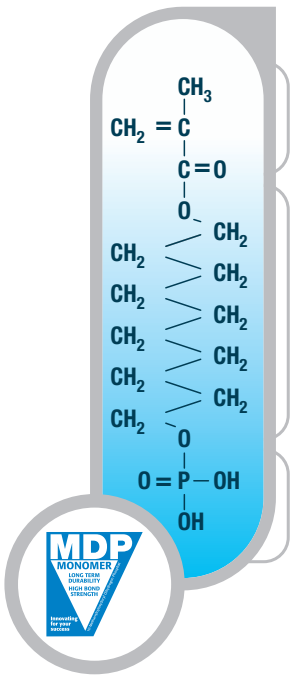
The Ohara Museum of Art in Kurashiki

MDP since 1981

What if Kuraray Noritake Dental had not developed the MDP monomer?

What would the quality of adhesive dentistry be if Kuraray Noritake had not developed the MDP monomer? MDP has proved to be a very effective functional monomer for creating durable bonding to enamel, dentine and metals. The best-known products containing MDP are CLEARFIL™ SE BOND and PANAVIA™.

Structure of Adhesive monomer MDP



Polymerisable group (1)

Hydrophobic group (2)

Hydrophilic group (3)
Forming the chemical bond with calcium in hydroxy apatite

Fig. 1 The chemical structure of adhesive monomer (MDP)

Adhesion to various substrates is possible Thanks to MDP (methacryloyloxydecyl dihydrogen phosphate), which has been shown to create a long term, durable and stable bond to both dental tissue and metal oxides. Research conducted over the past few decades has demonstrated the effectiveness of MDP. The first Kuraray Noritake Dental product to contain MDP was PANAVIA EX. Various other adhesive and cementation systems followed. Our latest products, PANAVIA™ V5 and CLEARFIL™ Universal Bond, also rely to a large extent on the performance of the original MDP monomer. MDP has the following structure:

1. terminal double bond group for polymerisation
2. hydrophobic alkylene group to maintain a delicate balance between hydrophobic and hydrophilic properties and
3. hydrophilic phosphate group for performance of the acid demineralisation and chemical bonding to tooth structure.

History

In the years between 1978 and the late 1990s, it became possible to increase the bond strength to dentine to more than the intrinsic strength of the dentine itself. MDP played a major role in these developments. The solid ionic bond with calcium from the HAp in dental tissue means that such failures as occur are cohesive in the dentine rather than being failures of the adhesive. Apart from in vitro studies confirming this bond strength, the long term clinical durability recorded over 13 years is also impressive.

Research

Research from Yaun et al., 2007, shows that defects along the interface are largely responsible for degradation of the hybrid layer. CLEARFIL™ SE BOND exhibited no such defects. So it was expected that SE BOND would also prove to have a stable connection to dental tissue. Recently, Peumans et al. From Leuven University, Belgium found CLEARFIL™ SE BOND to still have excellent clinical effectiveness after 13 years.

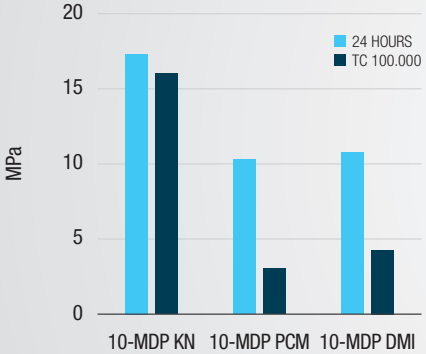
In their publication in the Journal of Dental Research 83, 2004, Yoshida et al. concluded that the choice of the adhesive monomer played a significant role in the effectiveness of the adhesive. They found MDP to be the best and fastest in tests for chemical adhesion (ionic bonding) and stability in a moist environment (insoluble) – better and more stable than 4-MET and Phenyl-P, in that order.

After 35 years, MDP is still in a class of its own. To date, no manufacturer has been able to develop an adhesive monomer with better adhesion properties combined with durable bond strength. Many attempts have been made, but none have succeeded. In the meantime, Kuraray's patent on MDP has expired. This has opened up the market for other manufacturers to synthesise their own MDP. Only a few non-dental chemical companies are supplying MDP to other manufacturers of adhesive systems, and the synthesis of high-purity MDP remains extremely difficult.

More recently, Kumiko Yoshihara et al. published 'Functional monomer impurity affects adhesive performance', in Dental Materials 31 (2015) 1493-1501. They concluded that the three MDP's they studied exhibited different levels of purity. Differences in the resultant hybrid layers were observed in all three MDP versions: both impurities and the presence of dimers had an effect on the etching efficacy of the HAp, and also on the intensity of nano-layer presence and the immediate bond strength.

µTBS of MDP's from different origin

Yoshihara Ket al. Functional monomer impurity affects adhesive performance Dent Mater 31, 1493-1501, 2015



KN: KURARAY NORITAKE JAPAN PCM: PCM GERMANY DMI: DMI USA

EXPLANATION

The three 10-MDP's studied in this study clearly revealed a different purity. Differences in the ultrastructure of the resultant hybrid layers were observed for the three 10-MDP versions. Both the impurities and the presence of dimers affected the etching efficacy of HAp, the intensity of nano-layering and the 'immediate' bond strength .

QUOTE

The purity of 10-MDP present in commercial dental primers, adhesives and cements can be expected to influence bonding performance.

Strong, stronger
Functional monomer research

Following the success of CLEARFIL BOND SYSTEM F, a new R&D goal was set: to develop a monomer that performed better than Phenyl-P, making it possible to achieve higher bond strengths and longer-lasting composite restorations as a result. To begin with, the chemical composition of Phenyl-P was analysed in depth. Each of the three main components of this functional monomer – in other words the polymerisable group, spacer and reactive group – was then studied in detail (see Fig. 1).

Chemical structure of adhesive monomer

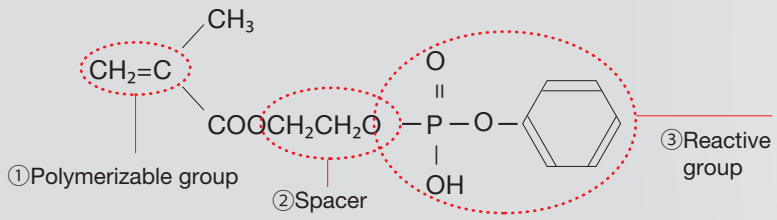


Fig. 1 The chemical structure of adhesive monomer (Phenyl-P)

One study involved changing the length of the spacer while keeping the other components the same. This demonstrated that the length of the spacer clearly influenced the bond strength to human dentine and Ni-Cr alloy. A similar test was carried out by exchanging just the reactive group (Fig. 2 and 3). These studies (Fig. 4) gave valuable insights into the ideal functional monomer. The results from our countless tests were as follows:

- The spacer must be a hydrophobic group with 4 or more carbon atoms.
- The reactive group must be a divalent phosphate group.
- There must be a radical polymerizable group.

Applying all these lessons to hundreds of functional monomer variations led to the development of a functional monomer still in use today: Methacryloyloxydecyl Dihydrogen Phosphate (MDP). We like to call it 'The Original MDP Monomer'.

Effect on the bond strength to dentin

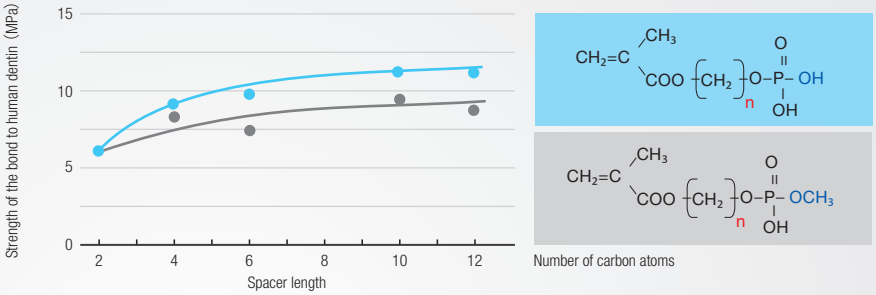


Fig. 2 Optimizing the chemical structure of the adhesive monomer

Effect on the bond strength to Ni-Cr alloy

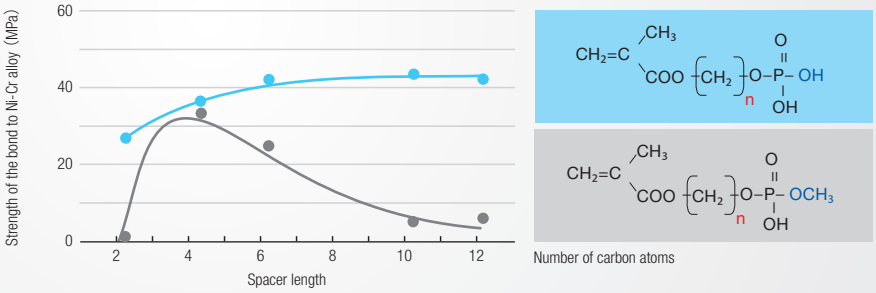
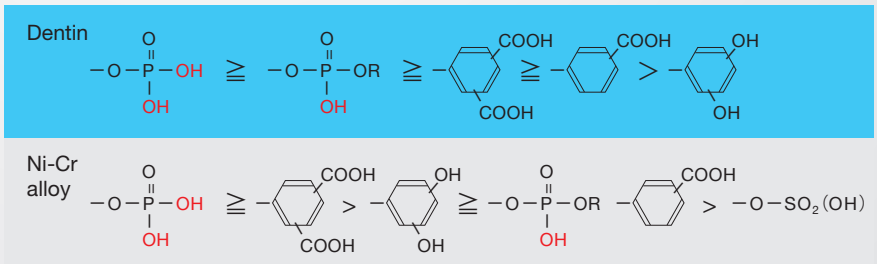


Fig. 3 Optimizing the chemical structure of the adhesive monomer

The Chemical structure of the reactive group



Impact of the polymerisable group on metal adhesion

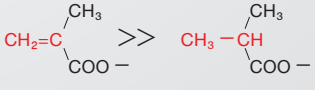


Fig. 4 Optimizing the chemical composition of an adhesive monomer

Clinical Report

Adhesive cementation of porcelain facings with PANAVIA™ V5

By Paul de Kok, Amsterdam (KVPA) Periodontic Clinic & ACTA

1 The Patient

Joris reported to the clinic with two discoloured composite two discoloured class IV composite restorations in tooth 11 and 21 11 and 21 (picture 1). These vital teeth were traumatized in his childhood. He was not satisfied with the aesthetics of the restorations neither with the overall shape and colour of the two teeth. It was therefore decided to make porcelain facings for tooth 11 and 21.

2 The preparation

In order to limit the sacrifice of healthy tooth tissue while still creating sufficient space for the porcelain, a preparation was chosen with an incisal reduction of 1.5mm and a buccal reduction of 0.5mm. A so-called depth cutter – a diamond drill with 0.5mm deep recesses – was used to achieve this (picture 2).

3 To be able to adjust the shape of the mid-line to the new facings, cutting was carried out centrally through the contact. From the distal aspect the contactpoint was remained. The thin shoulder was positioned equi-gingivally, so that a dry operative field could be achieved without damage to the gingiva.

The preparations were then finished using fine drills and polishing discs. The existing, well bonded diamonds composite restorations were left in situ (picture 3).

Paul de Kok studied dentistry at the ACTA and is an authorised restorative dentist at the Amsterdam Periodontic Clinic (KvPA), where he treats referred patients with restoration and aesthetic issues. In addition, Paul teaches indirect restorative dentistry at the Oral Functional Anatomy faculty of ACTA as well as conducting research in the Materials Science department. He also delivers lectures about this discipline at both a national and international level.

4 Since the transparent facings are very thin, the colour of the cut teeth is significant. The colour of the cores was therefore matched using the Natural Die colour guide (picture 4). Finally, impressions were made. Temporary restorations were placed by means of 4 spot etching points and bonding.

Cementation

To combine superior aesthetics with adequate strength, pressed lithium disilicate restorations were chosen for Joris. Prior to cementing the facings, they were tried for size and checked for marginal integrity, contact points, occlusion/articulation and aesthetics. Then the correct cement colour was established by

5 testing the facings with various try-in colours PANAVIA™ V5 Universal (A2); Universal (A2) appeared to be the most appropriate colour in Joris's case. The teeth were then polished with pumice and the facings were cleaned with alcohol, after which the teeth from 14 up to and including 24 were isolate by a rubber dam.

An incisor clamp was placed on the first teeth to be cemented. The facing was tried for fitting once more to ensure that it was free of contact with the rubber dam or the clamp and that the operative field of the preparation was totally dry (picture 5).

6 The facing was etched with 9% fluoricacid (picture 6) for 20 seconds to achieve micro-mechanical retention. It was then rinsed with water for 20 seconds before being neutralised in a solution containing ceramic neutralising powder. CLEARFIL™ CERAMIC PRIMER PLUS was then applied to the facing. This ensures chemical bonding between the facing and the composite cement thanks to the incorporated silane and MDP.

7 The adjacent teeth were separated by means of a transparent strip, after which the preparation was etched with 35% phosphoric acid (picture 7). TOOTH PRIMER™ was applied after thorough rinsing with water and drying after it had taken effect for 20 seconds.

A thin layer of PANAVIA™ V5 cement was then applied to the facing. The facing was placed on the preparation with the application of light finger pressure. A microbrush was used to remove the major excess along the margins. The cement of the buccal and palatal aspect was light cured for 5 seconds. A sharp scaler and floss were used to remove the final excess. Glycerine gel was then applied to the outline to avoid oxygen inhibition during curing. The

8 cement was finally light cured from both sides for 20 seconds, the glycerine gel was rinsed away and the margins were finished by means of a composite polishing stone. After placement of the first facing, the rubber dam clamp was moved to the neighbouring tooth so the cementation of the second facing could proceed. This facing was once more tried for fit, pre-treated and cemented in an identical manner (picture 8).

9 The result

The facings were checked a few weeks later (picture 9). Joris was very satisfied with the aesthetics of his two central incisors. The transitions from tooth to restoration were invisible and the gingiva was healthy.

10 The transparency, surface structure and gloss are better adjusted to the neighbouring elements and to Joris's smile (picture 10).

Dentist: Paul de Kok, Amsterdam Periodontics Clinic

Dental technician: Eric van der Winden, Oral Design Center Holland

PAUL DE KOK USED CLEARFIL™ CERAMIC PRIMER PLUS AND PANAVIA™ V5 FOR HIS CASE STUDY

PANAVIA™ V5

A predictable procedure.

PANAVIA™ V5. The cement for literally all permanent cementation indications, irrespective of the preparation or the material for bonding! The predictable procedure of PANAVIA™ V5 surprises by its unrivalled simplicity. Special PANAVIA™ V5 Tooth Primer for pre-treatment of tooth tissue. CLEARFIL™ CERAMIC PRIMER PLUS for pre-treatment of the restoration.

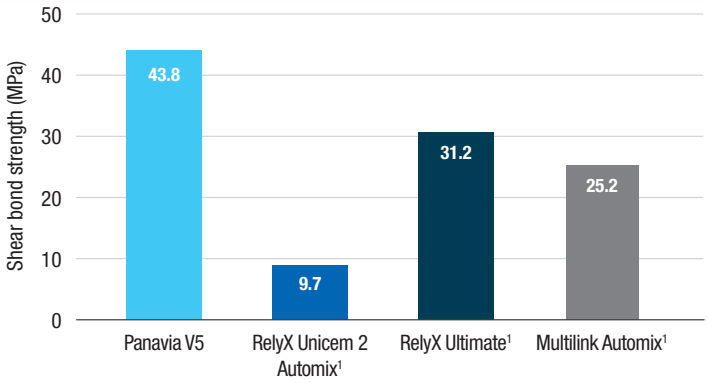
PANAVIA™ V5 is available in no fewer than five aesthetic shades and with its unparalleled adhesive strength it stands head and shoulders above other cements thanks to the unique MDP monomer. Experience this relaxed cementation method yourself. Standard handling of PANAVIA™ V5 ensures predictable results – time and again.

Research PANAVIA™ V5: the highest proven adhesive strength

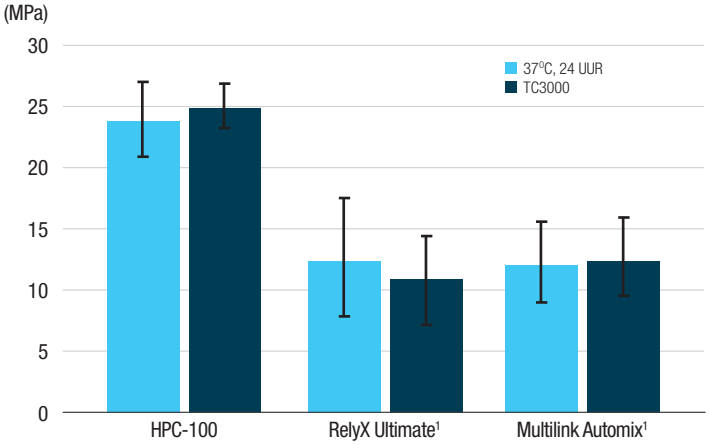
The objective of this research, conducted by Dental Advisor, was to establish the adhesive strength of PANAVIA™ V5 to human dentine in comparison with three other commercially available composite cements by using the Ultradent shear bond strength test involving a 24 hours' immersion in water (37° C). In a second research run, the new composite system HPC-100 (the working name for PANAVIA™ V5) also showed the highest adhesive strength to human dentine, after 24 hours and following thermo cycling (TC3000), in comparison with the two other composite cementation systems. This research has shown that HPC-100 provides reliable clinical performances and that it is superior to the other composite cementation systems that were tested during this research.

Conclusion

PANAVIA™ V5 provides the highest adhesive strength to human dentine as compared to the other composite cements tested.



Bron: R. Yapp, M.S., M. Cowen, BS, J.M. Powers, Ph. D. The DENTAL ADVISOR Biomaterials Research Center Dental Consultants, Inc., Ann Arbor, Michigan



Adhesive Property of a Newly Developed Resin Cement System "HPC-100", N. Kashiki, M. Takei, H. Nakayama, Kuraray Noritake Dental Inc., Tainai, Japan

1. Not a trade mark of Kuraray Co., Ltd.

CLEARFIL™ CERAMIC PRIMER PLUS

One silane, a predictable procedure, all materials*

CLEARFIL™ CERAMIC PRIMER PLUS is the ideal universal pre-treatment primer. The primer is ready to use – without mixing – for all your cementation indications and repair work. A single procedure for the entire job. You apply the primer and are allowed to blow it dry immediately before proceeding with your cementation or repair.

One procedure for all materials and indications

1. Apply CLEARFIL™ CERAMIC PRIMER PLUS.
2. Blow dry.

Surface treatment of indirect elements

Intra-oral repair of fractured restorations

Optimal combination of ingredients

CLEARFIL™ CERAMIC PRIMER PLUS is a combination of the purest adhesive MDP monomer for reliably-proven bonding to various materials, including metal oxides. Due to γ-MPS silane; it also provides strong adhesion to glass containing materials. Together, these properties mean that CLEARFIL™ CERAMIC PRIMER PLUS is an exceptionally versatile product. By virtue of its unique combination of ingredients, CLEARFIL™ CERAMIC PRIMER PLUS ensures an optimal pre-treatment, resulting in the excellent long-term bonding of your restorations.

* permanent cementation of all types of ceramics, metal, hybrid ceramics, metal oxide ceramics (zirconia oxide), glass fibre posts and composites

Comparison of Primers

frequently used primers

At this moment a lot of products for priming prosthetic materials are available.

This table shows the comparison of frequently used primers nowadays. CERAMIC PRIMER PLUS is the most versatile universal prosthetic primer for all cement and repair indications.

PRODUCT	CERAMIC PRIMER PLUS	RelyX Ceramic Primer**	Monobond Plus**	Monobond Etch & Prime**	Ceramic Primer II**	Cimara**	Silane**
manufacturer	Kuraray Noritake	3M	Vivadent	Vivadent	GC	VOCO	Ultradent
waiting time (sec)	0	0	60	20+40	0	120	60
rinse	no	no	no	yes	no	no	no
air dry	yes	yes	yes	yes	yes	no	possible
direct bond to composite (repairs)	yes	no	*	*	no (except flow)	no	no
SUITABLE FOR:							
feldspathic porcelain	+	+	+	-	+	+	+
leucite glass ceramic	+	+	+	+	+	+	+
lithium disilicate	+	+	+	+	+	+	+
zirconia & alumina	+	+	+	-	+	+	*
hybrid composite ceramic	+	+	+	-	+	*	*
composite	+	+	+	-	+	+	+
metal	+	+	+	-	-	+	-
gold alloy	+	*	+	-	-	-	-

* instructions for use are not clear on this topic
** Trademarks are property of their respective owners

CLEARFIL™ SE BOND

Excellent clinical effectiveness proven once more

CLEARFIL™ SE BOND has been intensively researched. Many of the studies, conducted mainly in-vitro, have shown the effectiveness of CLEARFIL™ SE BOND in terms of shear bond strength and flexural strength among other values. In vitro research helps to establish what can be expected in practical use, but what does this mean for your practice day to day?

The clinical effectiveness of CLEARFIL™ SE BOND is much more relevant. This has been proved effective yet again in a recently published 13 year clinical research project. CLEARFIL™ SE BOND is the only bonding which delivers such exceptional clinical results over such a long period of time.

13 YEARS CLINICAL EVALUATION OF CLEARFIL™ SE BOND

Thirteen-year randomised control clinical trial of a two-step self-etch adhesive in non-carious cervical lesions.

This study, conducted by professor M. Peumans and colleagues of KU Leuven-BIOMAT, has shown that the clinical effectiveness remains excellent in non-carious class V lesions after 13 years.

The aim of this randomised and clinically controlled test was to evaluate performance over a period of 13 years. CLEARFIL™ SE BOND was applied in non-carious class V lesions, with and without selective etching of the enamel margins of the cavities.

A total of 100 cavities were restored using CLEARFIL™ AP-X in 29 patients. For 50 cavities, the bonding procedure was preceded by selective etching of the enamel margins by means of phosphoric acid. The enamel margins of the remaining 50 cavities were not etched. The current publication describes the results after thirteen years. The earlier results from this study were previously published at five and eight years respectively.

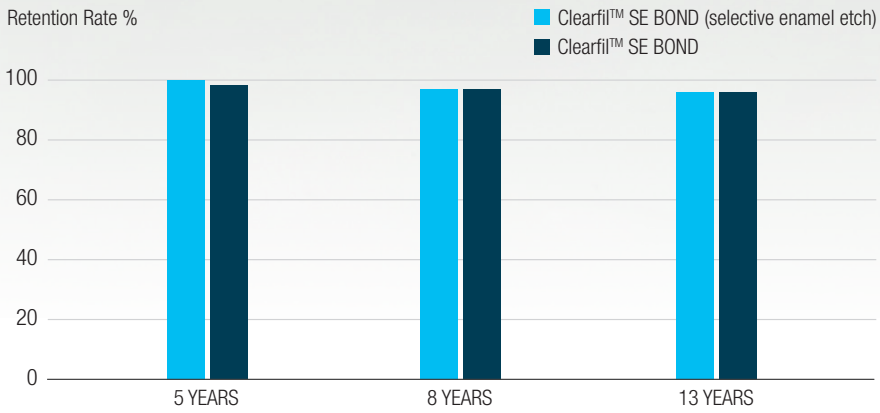
Loss of retention is certainly the most objective parameter in defining the bonding effectiveness in this kind of clinical test. The thirteen-year retention rate of CLEARFIL™ SE BOND remained very high in both groups – no less than 96%!

CONCLUSION

The clinical performance of CLEARFIL™ SE BOND remained excellent after 13 years in non-carious class V lesions, whereby selective etching of the enamel margins had only a limited positive effect on marginal integrity and the absence of marginal discolouration.

THE MILD, 2-STEP ADHESIVE CLEARFIL™ SE BOND DEMONSTRATED A CLINICALLY GOOD PERFORMANCE IN NON-CARIOUS CERVICAL LESIONS AFTER 13 YEARS*

RETENTION RATE AFTER 13 YEARS



*M. Peumans, J. De Munck, K Van Landuyt, B. Van Meerbeek. Thirteen-year randomized controlled clinical trial of a two-step self-etch adhesive in non-carious cervical lesions. KU Leuven- BIOMAT, department of oral Health sciences, KU Leuven & Dentistry, University Hospitals Leuven, Leuven, Belgium; Dent Mat 31(2015)308-314

Cementation of zirconia

Report of ACTA Congress

By: Jip Kreijns

Reliable adhesive cementation of zirconia 10-Methacryloyloxydecyl Dihydrogen Phosphate is a bit of a tongue-twister for anyone who is not a chemist by profession, so in everyday communication, this adhesive monomer is referred to by the three initial letters: MDP. MDP is indispensable in the dentistry business. For example, reliable adhesive cementation of zirconia restorations would not be possible without MDP. This adhesive monomer was developed by Kuraray Noritake Dental in 1981.

Requirements

Indirect restorations in modern dentistry must fulfil at least three requirements. First of all, they must be tissue-saving. This implies that a full crown is not the first choice, because approximately 70% of the tooth tissue has to be sacrificed for such a restoration. Nevertheless, full crowns are often still indicated by virtue of their mechanical retention. But given that the retention which can be achieved by adhesive cementation is now sufficiently reliable, a less invasive restoration than a crown should be chosen more often. And this choice may very well be for a zirconia restoration. Combined with the preliminary sandblasting of such an adhesive restoration, this choice is now an appropriate one thanks to MDP.

Durability is the second requirement for an indirect restoration. This quality of a restoration is largely associated with the flexural strength of the restoration material. While it has become clear that zirconia achieves the best durability scores, it should be pointed out that the cementation method also contributes significantly to the durability of a facing, inlay, onlay, etching bridge etc., which can nowadays all be realised in zirconia.

AESTHETICS

Aesthetic acceptability is the third requirement for a modern indirect restoration. This means that porcelain baked on metal

KATANA™ Zirconia UTML

KATANA™ Zirconia STML

KATANA™ Zirconia ML

These veneers were made from KATANA™ Zirconia UTML and coloured using CERABIEN™ ZR External Stain

has become a thing of the past; full-ceramic materials are now the standard. Zirconia still has a relatively poor reputation in terms of aesthetics due to the extreme whiteness of the earliest examples from the turn of the century. Types of zirconia are now available with varying translucencies, and there are even so-called multi-layer varieties (KATANA™ Zirconia ML, STML and UTML by Kuraray Noritake), and these new zirconia no longer have to be porcelain-baked. Obviously, baking is still possible, and partial baking is a choice that is frequently made. One of the results of a multi-layer build-up is that the transparency is higher incisally than cervically, as it is in natural elements; the light falls through the incisal margin, but is blocked at the cingulum of the restoration. With a modern zirconia material such as KATANA™ Zirconia ML, this variable transparency goes hand in hand with a natural colour gradient from cervical to incisal. In a given colour, A1 for example, the cingulum has the corresponding dentine shade body and it passes to incisal in the appropriate enamel colour via two transition shades.

SURFACE

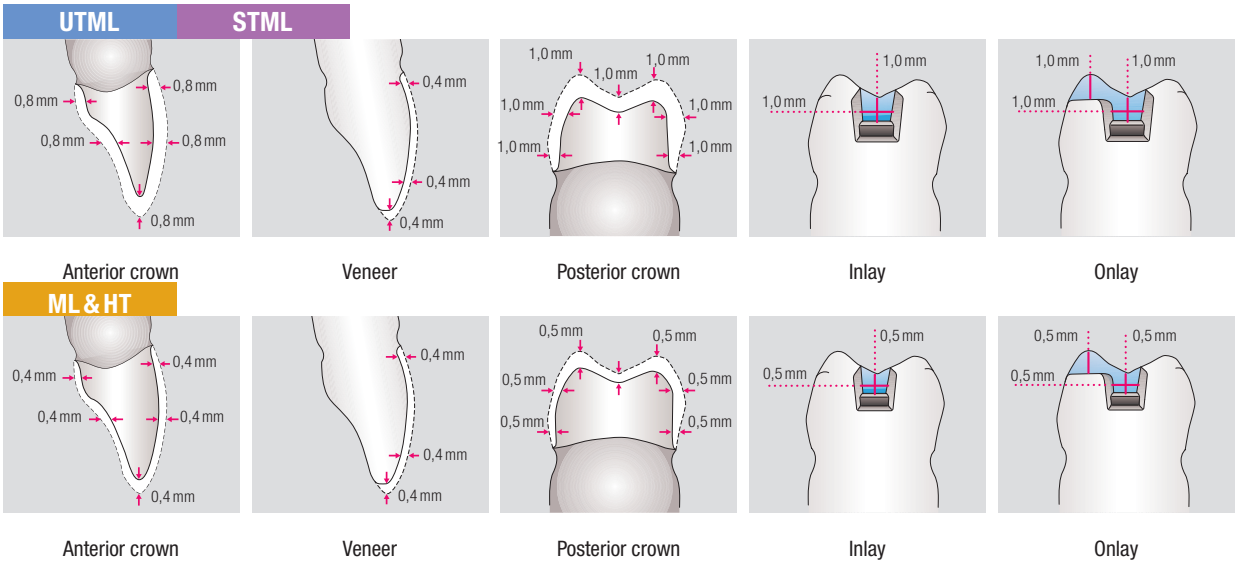
The new zirconia materials are changing the way dental technicians operate, as illustrated by the experience of Daniele Rondoni, a renowned dental technician. This professional, from Savona in Italy, has specialised in the use of Multi-Layering technology for ceramic materials (Tecnica della Multistratificazione in Ceramica). According to his philosophy, the choice of restoration materials should be so wide that customised solutions can be realised. Among other things, he believes that there will still be room for baked porcelain on a core of lithium disilicate or zirconia. Using baked porcelain, the dental technician can modify the surface texture of an aesthetic restoration to lend, as it were, a certain age to the restoration.

As for surface structure, the fact that the material allows for the smooth polishing of the occlusal plane is crucial to counteract abrasion by the antagonist and to maintain the occlusal balance. In this respect, the hardness of the material selected is not the main factor; the smoothness and resistance of the surface are far more important.

FLEXURAL STRENGTH

When selecting material for restorations, the dental technician also has the option to choose KATANA™ Zirconia Ultra Translucent Multi-Layered for veneers or anterior crowns; a zirconia with a translucence comparable to that of glass. This translucence is especially important with anterior restoration which is to be fitted between flawless natural elements, a situation that often occurs after anterior traumas. Such a restoration effected using KATANA™ Zirconia UTML harmonises with the neighbouring natural teeth, not least because this type of zirconia does not cause the frequently-occurring white appearance common in anterior crown. The modern aesthetic zirconia materials of the second generation are sintered at a temperature of 1,550°. This temperature is maintained for two hours. The dental technician needs to be aware that this temperature differs from the sintering temperature for KATANA™ Zirconia High Translucent Multi-Layered (1,500 °C). Wide-span bridges can be realised with the latter product, whereas the size of bridges made from KATANA™ Zirconia Super Translucent Multi-Layer remains limited to a maximum of four elements. KATANA™ Zirconia UTML can be used for small anterior bridges, but is more suitable for anterior crowns and veneers. The reason for this is that the flexural strength of these highly aesthetic zirconia materials is lower than the flexural strength of the standard zirconia, in which the flexural strength

Minimum wall thickness of KATANA™



* Maintain 0.8 mm thickness of pressed ceramic in all areas. When trimming of the zirconia framework the framework should be at least 0.4 mm.

– 1,125 MPa – is sufficient for the production of durable wide-span bridges. The flexural strength of the highly aesthetic zirconia varieties (approximately 750 MPa (STML) and 550 MPa (UTML)) is amply sufficient to ensure the durability of solitary aesthetic restorations and limited-span bridges.

PREPARATION

Flexural strength is not the only decisive factor for durability; the method of preparation is also crucial to properties of this material. Chamfer preparation is the required form of preparation, with no knife-edge outline, no deep shoulder and, obviously, no undercuts. Since the restorations are fixed adhesively, parallel walls or grooves in the preparation are undesirable, and sharp edges and transitions must be rounded off. If a preparation for a full crown has nevertheless been made, a substantial height difference between the vestibular and palatal/lingual outline is contra-indicated.

Using the new zirconia materials means that a thickness of only 0.4 to 0.8mm need be removed for a veneer in the incisal and cervical area, and only 0.5mm is required in the labial plane, which corresponds with the requirement to save tissue. For inlays, too, only 1mm is sufficient to achieve a durable result. If the inlay is extended to an onlay, 1mm is also sufficient for the area where the cusps are capped. For a full crown in the lateral parts, a 1mm space must be kept as a minimum, which thickness must also be maintained for the upright walls of the preparation.

FIXATION

A wide range of possibilities have already been suggested for the durable fixation of zirconia-based restorations. All of these options have also been researched, but according to Prof. Matthias Kern, there is no point in conducting further research into the best cementation procedure. This scientist and practitioner, who currently works at Kiel University, in Germany, has been involved in the adhesive cementation of zirconia for nearly twenty years. Based on his wide experience, Kern is convinced that three requirements have to be met to achieve the reliable cementation of zirconia. First of all, a rubber dam must be applied for the operation, which is obviously easier for partial restorations than for total restorations. It is not only from the perspective of tissue-saving that it is useful to keep the preparation limited for this reason. The second condition is that micro-mechanical adhesion needs to be achieved. For zirconia restorations, the necessary adhesion is obtained by sandblasting the surface. Obtaining chemical adhesion is the third condition.

Based on extensive research, Kern is fully convinced that chemical adhesion can only be achieved by using MDP. His first publication on this subject dates back to 1998. It was the use of Kuraray Noritake's PANAVIA, which did indeed contain MDP, which made it possible to achieve durable synthetic resin bonding to zirconia after sandblasting.

SANDBLASTING

Dentists and dental technicians are apparently somewhat averse to sandblasting*, as evidenced by the extensive research conducted in an attempt to find an alternative. No such alternative has yet been found. Efforts have been made to fuse a silica layer onto the zirconia to improve bonding, but according to Kern, the results of this procedure – the Rocatec method, for example – have been disappointing. Nor is the silanisation of a zirconia restoration effective, because zirconia does not react to silan. Dentists who want to achieve the durable cementation of their zirconia restorations therefore have no other option than the purchase of a sandblasting device. Sandblasting can be carried out in a small cabin to prevent the surrounding area of the practice from being affected. Soft air abrasion is carried out at 0.5 bar, while tight air abrasion is performed at 2.5 bar. The exact pressure is not all that crucial to the adhesion of the zirconia, providing that it is between 0.5 and 2.5 bar**. Kern advises sandblasting at a pressure of 1 bar, so that the surface to be bonded becomes somewhat rougher without this being visible to the naked eye. Obviously, the part of the restoration that does not require bonding, such as the outside of a veneer or the dummy of an etching bridge, has to be protected from the effect of the abrasive grains. It is also advisable to apply a colorant (waterproof marker pen) to the area to be sandblasted prior to the operation. The colour disappears during sandblasting, making it easy to check that the entire adhesive surface has actually been abraded.

SANDBLASTING

Sandblasting of zirconia oxide at a lower pressure is a requirement for an effective adhesion. The combination of sandblasting and MDP ensures both mechanical adhesion in the micro-roughness and chemical adhesion between zirconia dioxide and MDP. There is extensive research material to corroborate the effectiveness of this method.

* It had long been assumed that the tetragonal and/or cubic structure would relapse into a monoclinic state due to sandblasting, as a result of which fracturing would occur because of the associated expansion. Sandblasting with aluminium oxide particles of 50 micron as a maximum and a maximum air pressure of 2.5 bar does not, however, cause any damage.

** Airpressure is different from manufacturer's recommendation.

Adhesive monomer

The restoration surface can be cleaned using alcohol after the sandblasting process. This step is optional. If the alcohol becomes contaminated, for example, by saliva residues, the effect will be negated, because the sandblasted surface would be contaminated as well. The choice of the fixation procedure is relatively simple provided MDP is used. This adhesive monomer was developed in 1981 by Kuraray Noritake Dental to improve the adhesive strength to hydroxyapatite, and has proved its strength ever since. MDP is not present in the glass ionomer cements (GIC's), which, because of their ease of use, are also sometimes used for the cementation of zirconia restorations. 'Don't!' warns Kern. It is clear from all the studies that the composite cements containing MDP provide the most durable results. The oldest known cement from this category is PANAVIA™ EX, which was introduced in 1983. The optimised PANAVIA™ V5 was presented recently as the single cement for all cementation indications guaranteed to work according to a predictable procedure. All the cements and bondings produced by Kuraray Noritake contain MDP.

Possibly because Kern conducted his research in Maryland for two years, he has recorded remarkable results with adhesively cemented Maryland bridges (etching bridges). It has also become apparent that, most of the time, an adhesion bridge functions best with only one wing. For example, if a one-wing zirconia adhesion bridge is cemented using a cement containing MDP instead of a lateral upper incisive adhesive, such an adhesion bridge may remain in place for up to 20 years, to the satisfaction of both dentist and patient. This restoration, with its survival rate of 95.2% after five years, therefore qualifies as a permanent restoration. And the same goes for an onlay bridge made from zirconia.

Sandblasting and MDP; the formula for the durable bonding of zirconia restorations.

So bear in mind: MDP also stands for a Mega Durable Product.

Daniele Rondoni
Owner of a dental laboratory in Savona

Professor Matthias Kern
Christian-Albrechts University

PANAVIA™ V5 for the adhesive fixation of zirconia

Achieving a reliable bonding to zirconia – it can be done! Read all about it in the preceding article.

PANAVIA™ V5 is the successful successor to both PANAVIA™ F2.0 and CLEARFIL™ ESTHETIC CEMENT. Thanks to its excellent adhesive bond with both dental tissue and all indirect materials, superior aesthetics, and unambiguous processing, PANAVIA™ V5 is a popular bonding cement. PANAVIA™ V5 provides a single cement for all cementation indications and features an unambiguous procedure.

CONCISE INSTRUCTIONS FOR USE

1. Sandblast the zirconia surface to be bonded with aluminium oxide powder (30-50 µm) at low pressure, then clean the restoration in an ultrasound bath and allow it to dry.
2. Apply CLEARFIL™ CERAMIC PRIMER PLUS to the restoration surface, then proceed to Apply & Go. Dry the entire surface using a gentle air flow.
3. Apply PANAVIA™ V5 Tooth Primer to the element and leave it to take effect for 20 seconds. Dry the surface with air.
4. Apply PANAVIA™ V5 Paste to the restoration surface and position the restoration.

Applying the paste.

Positioning
After placement, remove excess cement using a gauze, a small brush, or something similar.

5. Remove surplus cement and light-cure. Always take account of the self-curing time needed for opaque elements and the use of PANAVIA™ V5 Opaque.

KATANA™ ML and Cerabien™ ZRN

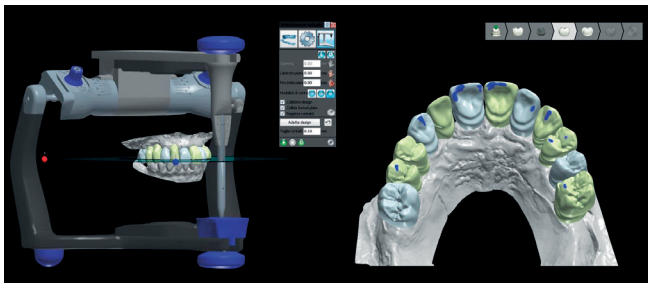
Screw-retained implant bridge

D.T. Pier Francesco Golfarelli - Noritake Italian Study Club Teacher, Forlì

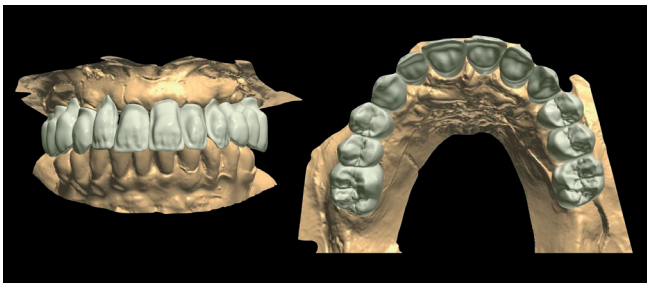
Digital workflow and CAD/CAM shaping have now become a daily practice that helps to manage most cases, including the most extensive re-adaptations (rehabilitations).

KATANA™ ML zirconia was selected, in consultation with the specialist, for the case presented here. It was principally chosen for its aesthetic and mechanical properties. One of our selection criteria was the advantageous lower abrasiveness level of zirconia. Because of its density, this material is less abrasive than the more traditional ceramics in combination with adequate mechanical polishing. Based on the initial situation, once the assembly in the articulator was completed, we designed a structure with anterior cutbacks for maximum aesthetics, while for the posterior teeth a monolithic solution was chosen for maximum strength and quality of the functional surfaces.

With the CORE & SHELL technique developed by the Noritake Italian Study Club, I can now fully exploit the optical properties of KATANA™ zirconia by integrating it, in the anterior area, with Noritake Cerabien™ ZR ceramics. In the images here you can see the aesthetic results of the anterior and side areas, the mechanically polished monolithic surfaces and the special Noritake glaze.



CAD Shaping - 3Shape Dental Designer



Structure design with cutbacks

KATANA™ ML structure

Occlusal surface - details

Shade stain

Shade Stain (SS)

Core

Internal Live Stain (ILS)

Shell

Shell Tissue

Layering Details

It’s time to support your science

We would like to introduce you to our European Scientific Team. Each year, we support universities with products for research or ask universities to conduct in vitro or in vivo analysis of our products. We currently have more than 12 commissioned studies of one of our new products in progress at various European universities. The Kuraray Noritake company appreciates every effort made in studying Kuraray products to confirm their quality or to indicate room for improvement.

Our European head office is located in Hattersheim, near Frankfurt in Germany, and it is from there that we support the technical managers of our subsidiaries, as well as European universities. Have you ever wanted to visit our company or talk to a member of our R&D team? This may well be your chance. Our current technical team consists of various Japanese and European members. If you would like to contact our technical team, please refer to the contact information provided below.

Each year, we provide free materials for research and student projects. If you would like to known whether you might benefit from our scientific programme, please feel free to contact us to establish how we could help you and what information you will need to supply.

And that is not all. Starting this year, we will be gradually opening up our online database of product information. Here you will be able to find presentations, photos etc. for free downloading and sharing. We are going to begin with our latest introduction – PANAVIA™ V5. Just send us an e-mail expressing your interest and you will be among the first to be invited.

You can contact us by sending an e-mail to science@ kuraraynoritake.com.

We look forward to hearing from you!

Mitsuru Takei
Head of Technical Services