
Monomers and curing technology

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Transforming dentistry with ground-breaking technologies: Cementation of indirect restorations

Some companies mainly make use of basic technologies developed by others to improve their products and introduce new ones, while other companies conduct fundamental research and technology development inhouse. Is this difference relevant for someone who uses the resulting products in the dental practice or laboratory on a daily basis? It is – as companies with a deep understanding of the underlying components, chemistry and technologies are able to solve existing problems and respond to market needs flexibly and quickly. This article describes the impact of several basic technologies developed by Kuraray Noritake Dental Inc. on the cementing of indirect restorations.

Adhesive cementation then and now

The possibility of milling dental restorations from different kinds of ceramics has opened up new opportunities in prosthodontics: highly aesthetic restorations can be produced and placed. What is often undervalued in this context is the role of adhesive cementation systems, which not only support the aesthetic appearance of the translucent, tooth-coloured restorations, but also pave the way for less invasive preparation and restoration designs. Early systems that provided for chemical adhesion between teeth and indirect restorations unfortunately offered a compromised long-term behaviour and high technique-sensitivity, while the application procedure was extremely complex. Technology development at Kuraray Noritake Dental Inc. made significant contributions to an improved long-term bonding performance of the systems and a simplified handling.

Optimizing the long-term bonding performance

In order to achieve long-term bonding of early cementation systems to tooth structure (especially dentin), Kuraray, a parent company of Kuraray Noritake Dental Inc., decided to focus on the development of a more powerful adhesive monomer in the 1970s. As a first step on its road to excellence, it introduced the phosphate monomer Phenyl-P in 1976. Five years later, continued efforts in improving and refining its molecular structure led to the introduction of the popular MDP Monomer that is capable of establishing a particularly strong and long-lasting bond to enamel, dentin, metal and zirconia.

The fact that it is still part of every adhesive and adhesive cementation system from Kuraray Noritake Dental Inc., and meanwhile also used by other manufacturers to optimize the bond strength and bond durability of their products, stresses the ingenuity of the invention. Compared to MDP synthesized elsewhere, the Original MDP Monomer from Kuraray Noritake Dental Inc. stands out due to an unmatched level of purity. Independent Studies show that this level of purity has a positive effect on its bonding behaviour¹. By offering stability in a moist environment, the MDP Monomer has contributed to a more consistent performance of the products containing it.

Different MDP Monomers offer different levels of purity and a different bonding performance.

Three experimental self-etch primers were prepared consisting of 15 wt.% 10-MDP provided by different sources: KN (Kuraray Noritake Dental), PCM (Germany) or DMI (Designer molecules Inc., USA). Data courtesy of Dr. Kumiko Yoshihara.

For adhesive resin cement systems to deliver a strong bond with an outstanding marginal seal, however, simply containing an adhesive monomer is not enough. Effective polymerization of this monomer is necessary as well – and not always that easily accomplished. In order to provide for an effective light-cure and dark-cure performance of PANAVIA™

V5, Kuraray Noritake Dental Inc. developed the Touch-Cure Technology. The key part of this technology is a newly developed, highly-active polymerisation accelerator in PANAVIA™ V5 Tooth Primer that is able to coexist with the acidic MDP Monomer promotes polymerisation starting from the interface between the tooth and the cement as soon as PANAVIA™ V5 Paste is applied to the already primed tooth surface. In PANAVIA™ Veneer LC – a light-curing resin cement system that works with the same primers – the polymerisation accelerator in PANAVIA™ V5 Tooth Primer shows the same mechanism of action. It contributes to the polymerization of the adhesive interface, while PANAVIA™ Veneer LC Paste offers excellent ambient light stability and is polymerized by light curing.

For example, this phenomenon was evaluated for PANAVIA™ F2.0, the predecessor of PANAVIA™ V5. The result of the study: PANAVIA™ F2.0 showed much better marginal sealing properties than other cement systems evaluated². This documented secure sealing of the interface leads to a lower incidence of marginal leakage, to a very high polymerisation ratio even in the self-cure mode (without light curing or wherever the light is blocked by the restorative material) and hence to a particularly strong bond.

An additional benefit arising from the incorporation of the polymerisation accelerator is its function as a strong reductant. It neutralizes sodium hypochlorite, which is commonly used as an irrigation solution during endodontic treatment, and thus eliminates its negative effect on the bond strength of the subsequently applied cement paste.

A highly active polymerisation accelerator in PANAVIA™ V5 Tooth Primer promotes effective polymerisation of the cement at the adhesive interface.

Simplifying glass-ceramic cementation

Fewer bottles, fewer steps and streamlined cementation procedures: that is why self-adhesive resin cements have been developed and introduced in the early 2000s. Most of these products, however, have a limited indication range. They work well on zirconia, metal, enamel and dentin, but are either not recommended or need an extra silane primer for glass-ceramic bonding. The MDP-containing PANAVIA™ SA Cement Universal is different due to another proprietary technology from Kuraray Noritake Dental Inc.: the LCSi Monomer, a Long Carbon-chain Silane coupling agent. This monomer forms a strong chemical bond with resin composite, porcelain and silica-type ceramics (like lithium disilicate), so that the need for a separate silane component (a primer or adhesive) is eliminated. By leveraging the benefits of this technology, PANAVIA™ SA Cement Universal clearly sets itself apart from other self-adhesive resin cements as a true single-component cementation system even for restorations made of glass ceramics.

If desired, the product's bond strength to tooth structure can be increased by use of the popular universal adhesive CLEARFIL™ Universal Bond Quick featuring Rapid Bond Technology. This technology has been developed by Kuraray Noritake Dental Inc. to solve problems related to the slow penetration of tooth structure, especially wet dentin, typical for universal adhesives. In order to provide proper penetration, these adhesives need to be actively rubbed into the tooth structure for a long time or users have to wait for some time before light-curing the layer. Consisting of the Original MDP monomer combined with hydrophilic amide monomers, the proprietary Rapid Bond Technology provides for a high affinity to water leading to a rapid and deep penetration of wet dentin. As a consequence, application times are shortened and handling is simplified without negatively affecting the bonding performance.

Conclusion

Technologies developed by Kuraray Noritake Dental Inc. have strongly contributed to an improved bonding performance of adhesive cementation systems and a truly universal use of self-adhesive resin cements. As a consequence, the company offers a streamlined portfolio of high-performance resin cements for every user, for the typical clinical situations. Fewer components and fewer steps are necessary and procedures simplified – for fewer errors and aesthetic restorations that last. Apart from the technology-related benefits, the products mentioned offer many additional beneficial features. A detailed description is found online at kuraraynoritake.eu.

References

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