Reliable adhesive cementation of zirconia 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 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, adhesive 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...
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 hardiness 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
Air pressure is different from manufacturer’s recommendation.

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.

**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.

**Air pressure 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 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 (adhesive bridges). It has also become apparent that, most of the time, an adhesive bridge functions best with only one wing. For example, if a one-wing zirconia adhesive bridge is cemented using a cement containing MDP, replacing a maxillary lateral incisor, such an adhesive 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.

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.