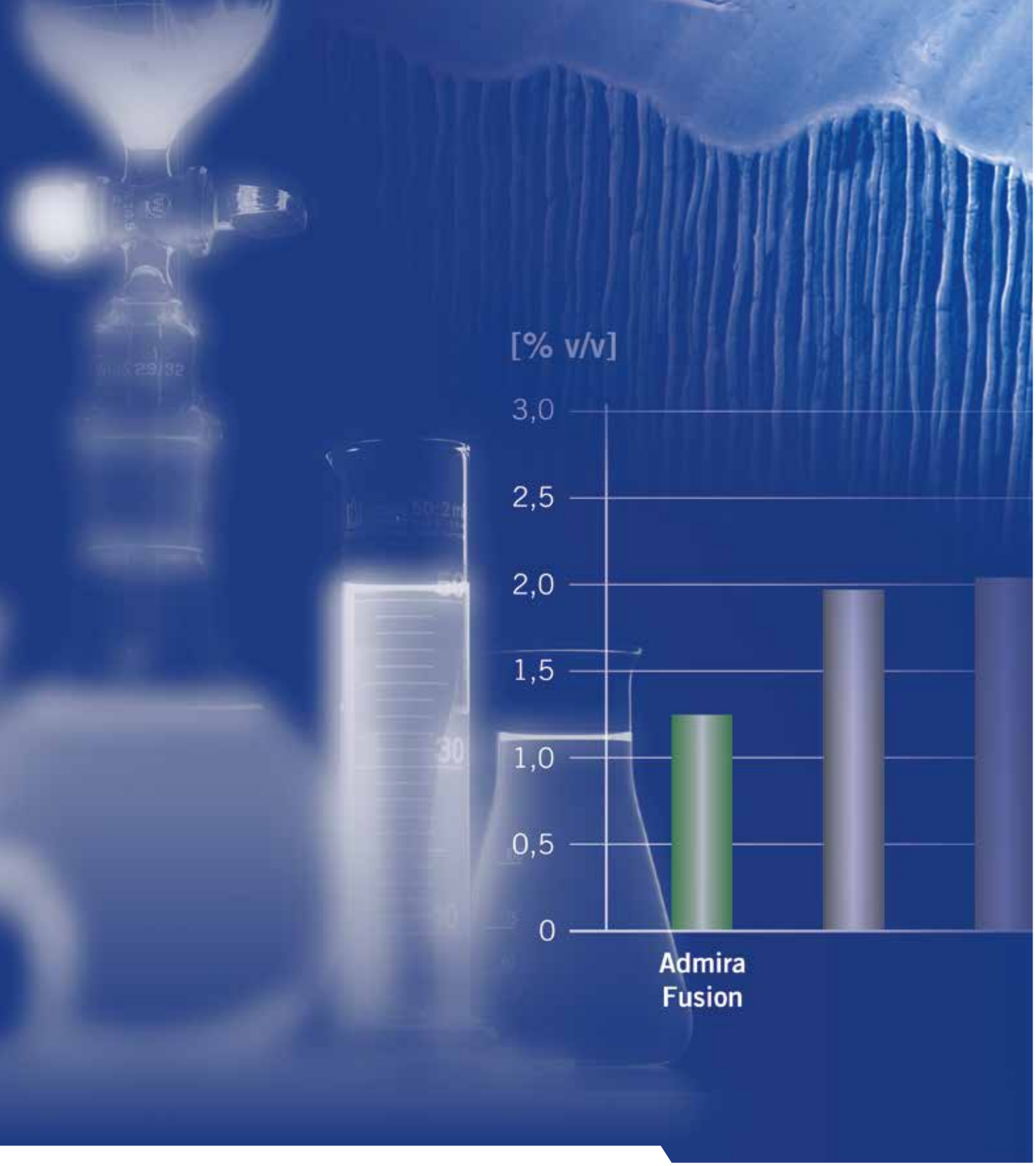


Admira Fusion

SCIENTIFIC COMPENDIUM

VOCO
THE DENTALISTS

Contents

1. Introduction

Admira Fusion is the world's first purely ceramic-based restorative material. It unites two outstanding innovations: nanohybrid technology and ORMOCER® technology. In addition to very low polymerisation shrinkage and low shrinkage stress, the material is characterised by its high biocompatibility, which is attributable to the fact that the chemical basis of Admira Fusion is silicon oxide – in terms of the fillers (nano and glass ceramic filler particles) and the resin matrix alike. This innovative "Pure Silicate Technology" makes Admira Fusion a purely ceramic-based restorative material for the fabrication of high-quality restorations in the anterior and posterior regions. The following image shows the matrix of Admira Fusion. The transmission electron microscopy image shows the individual components of Admira Fusion in impressive detail. The glass ceramic particles and nanoparticles (shown in light grey) are firmly embedded in the ORMOCER® resin matrix (dark grey). The schematic representation on the right highlights the similarity of the components once again: the chemical basis is always silicon oxide. Another important factor is that Admira Fusion is a smooth, non-sticky material, which is easy to use and sets a new benchmark both as far as its handling is concerned and in terms of its strength and stability. The ease of high-lustre polishing coupled with high surface hardness and high colour stability guarantee durability and aesthetics.

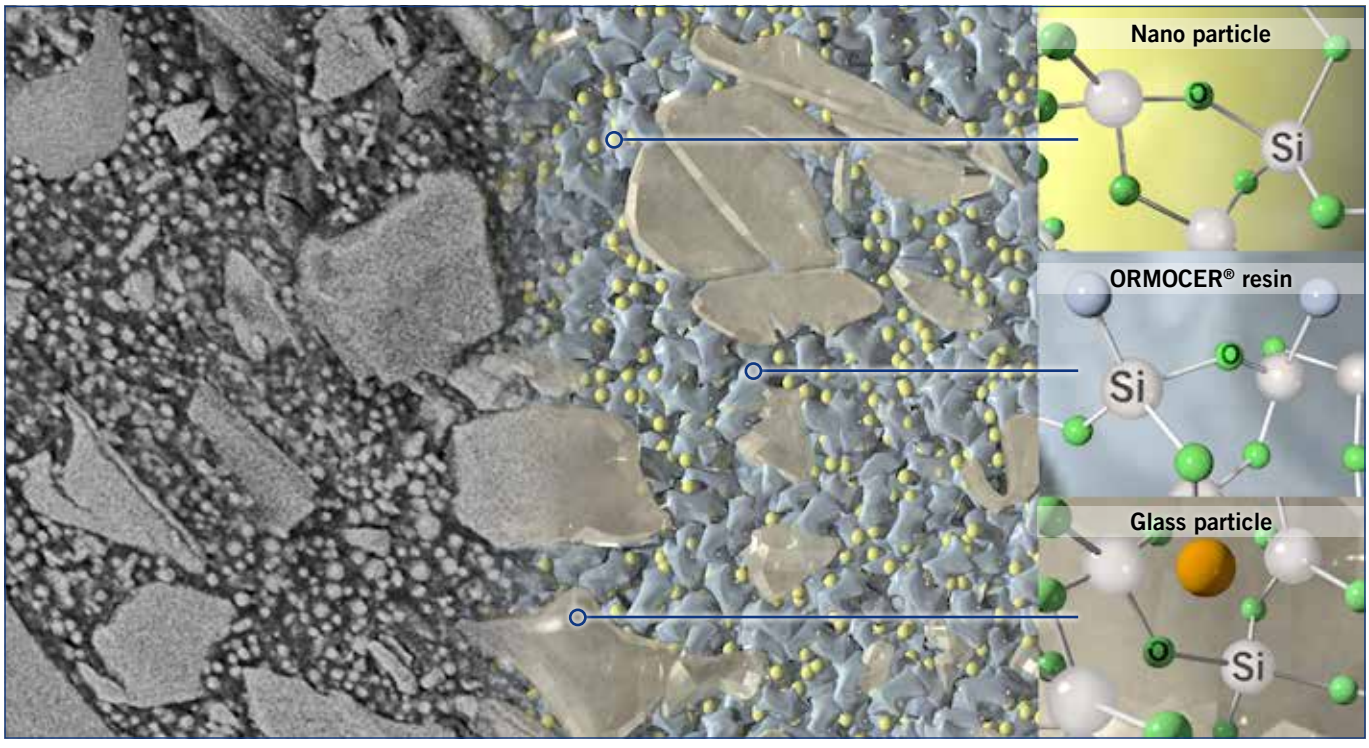


Illustration of Pure Silicate Technology

Left: TEM image of Admira Fusion at 20,000x magnification (Behrend 2014).
Right: Schematic representation of the TEM image with legend.

This Scientific Compendium provides information on the technical properties of Admira Fusion. It presents study data on the marginal integrity, biocompatibility, strength, surface quality, behaviour in aqueous environments and handling properties of Admira Fusion in detailed comparisons with other leading restorative materials on the market.

2. Technical Data Sheet and Indications

2.1. Technical Data Sheet

Admira Fusion		
Filler content	84.0 % w/w	DIN 51081
Polymerisation shrinkage	1.25 % v/v	analogous Watts et al.
Shrinkage stress	3.71 MPa	analogous Watts et al.
3-point flexural strength	132 MPa	ISO 4049
Modulus of elasticity	9.8 GPa	ISO 4049: 1988
Compressive strength	307 MPa	analogous ISO 9917
Surface hardness	141.3 MHV	University of Rostock, Germany
Edge strength	171.9 N	University of Manchester, UK
Radiopacity	305 %Al	ISO 4049
Resistance to ambient light	198 s	ISO 4049
Water absorption	13.4 µg / mm^3	ISO 4049
Water solubility	≤ 0.1 µg / mm^3	ISO 4049
Thermal expansion coefficient (α)	$40.3*10^{-6}$ / K	Fraunhofer Institut Würzburg, Germany
Depth of cure	2.7 mm	ISO 4049
Tensile bond strength to enamel (with Futurabond M+: self-etch mode)	30.0 MPa	University of São José dos Campos, Brazil
Tensile bond strength to dentine (with Futurabond M+: self-etch mode)	23.8 MPa	University of São José dos Campos, Brazil

2.2. Indications

Class I to V restorations

Base in class I and II cavities

Reconstruction of traumatically damaged anteriors

Facetting of discoloured anteriors

Correction of shape and shade for improved aesthetic appearance

Locking, splinting of loose anteriors

Repairing veneers, small enamel defects and temporary C&B-materials

Extended fissure sealing

Restoration of deciduous teeth

Core build-up

Composite inlays

3. Physical parameters for marginal integrity of Admira® Fusion

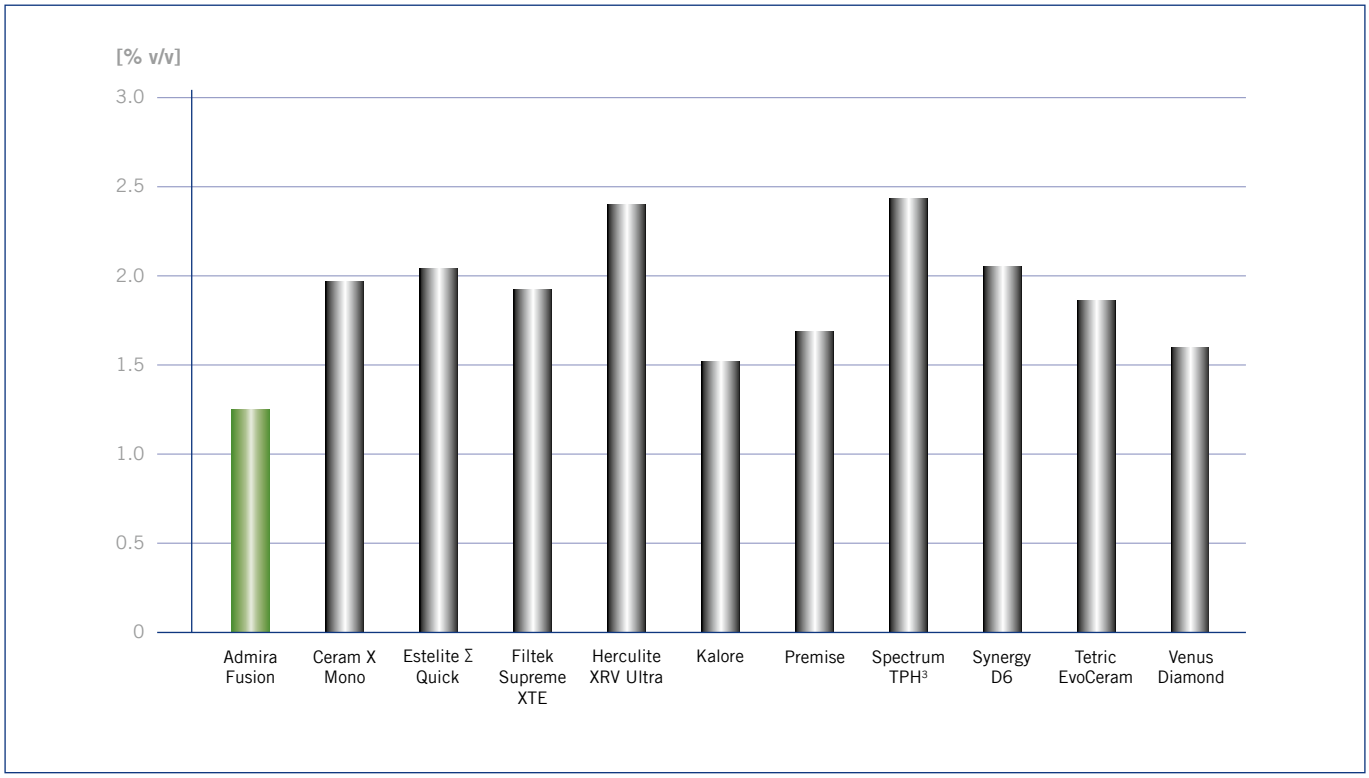
3.1. Shrinkage

Measurement procedure

The volume shrinkage during polymerisation was determined in accordance with the bonded-disc method described by Prof. Watts (University of Manchester).[1-3] A disc-shaped test specimen of the restorative material with a diameter of approx. 8 mm and a thickness of approx. 1 mm was light-cured from below for a total of 40 seconds (Celalux 2, Softstart, VOCO). From the beginning of the light-curing, the polymerisation shrinkage was recorded with a sensor from the opposite side (top surface) for a period of 30 minutes.

Results

At just 1.25 % by volume, Admira Fusion is the material with the lowest volume shrinkage compared with the other restorative materials studied.



Volume shrinkage of various restorative materials during light-curing (VOCO 2014).

Literature

[1] Kim SH, Watts DC, 2004.
[2] Watts DC, Cash AJ, 1991.
[3] Watts DC, Marouf AS, 2000.

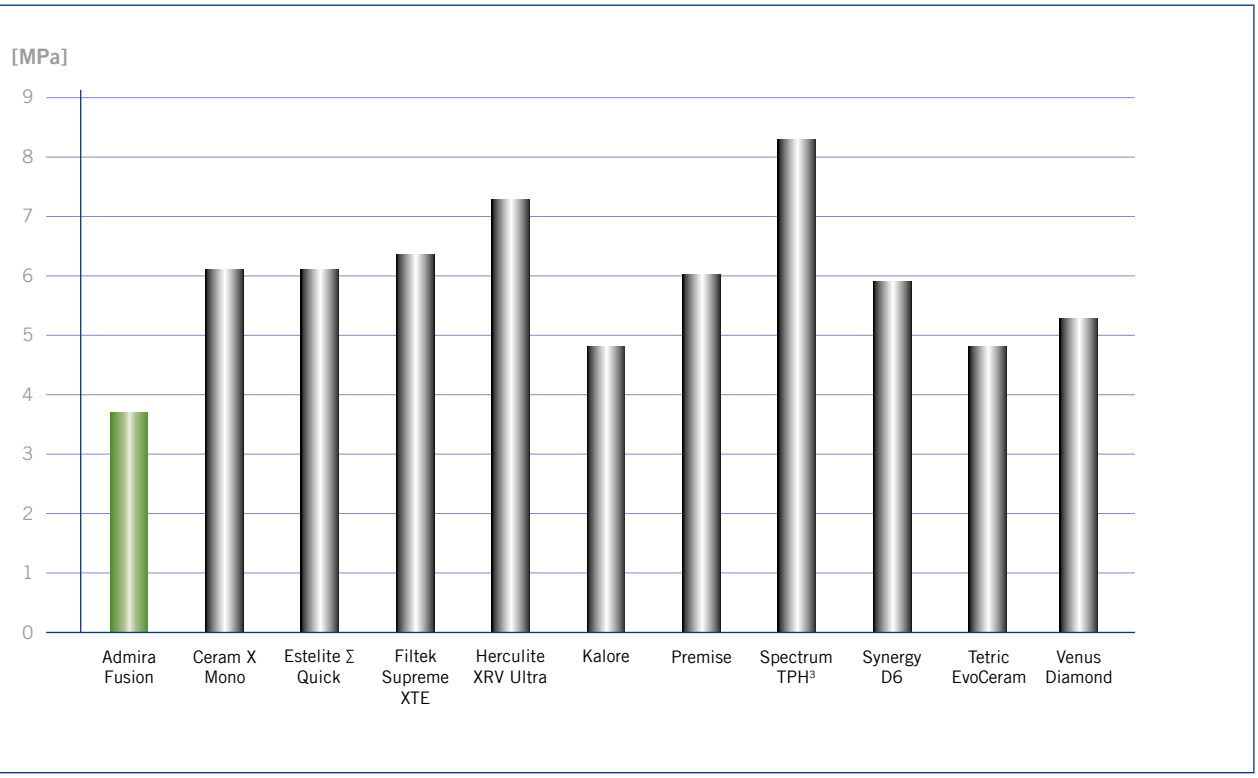
3.2. Shrinkage stress

Measurement procedure

The shrinkage stress following curing was determined in accordance with the "bioman" method described by Prof. Watts (University of Manchester).[1-2] The method involves curing a cylindrical sample of the material with a height of 0.75 mm and a diameter of 8 mm from below through a fixed glass plate for 40 seconds. On the top surface of the resin-based restorative material is a steel cylinder connected to the measuring apparatus and roughened in advance with a sandblaster. The force exerted on this cylinder is recorded for a period of 30 minutes and then the resulting polymerisation stress of the restorative material is calculated.

Results

The shrinkage stresses were around 6 MPa for the majority of the tested materials. Of all the restorative materials tested here, Admira Fusion has the lowest shrinkage stress of just 3.7 MPa.



Extent of the shrinkage stresses [MPa] of the tested restorative materials (VOCO 2014).

Literature

[1] Watts DC, Satterthwaite JD, 2008.

[2] Watts et al., 2003.

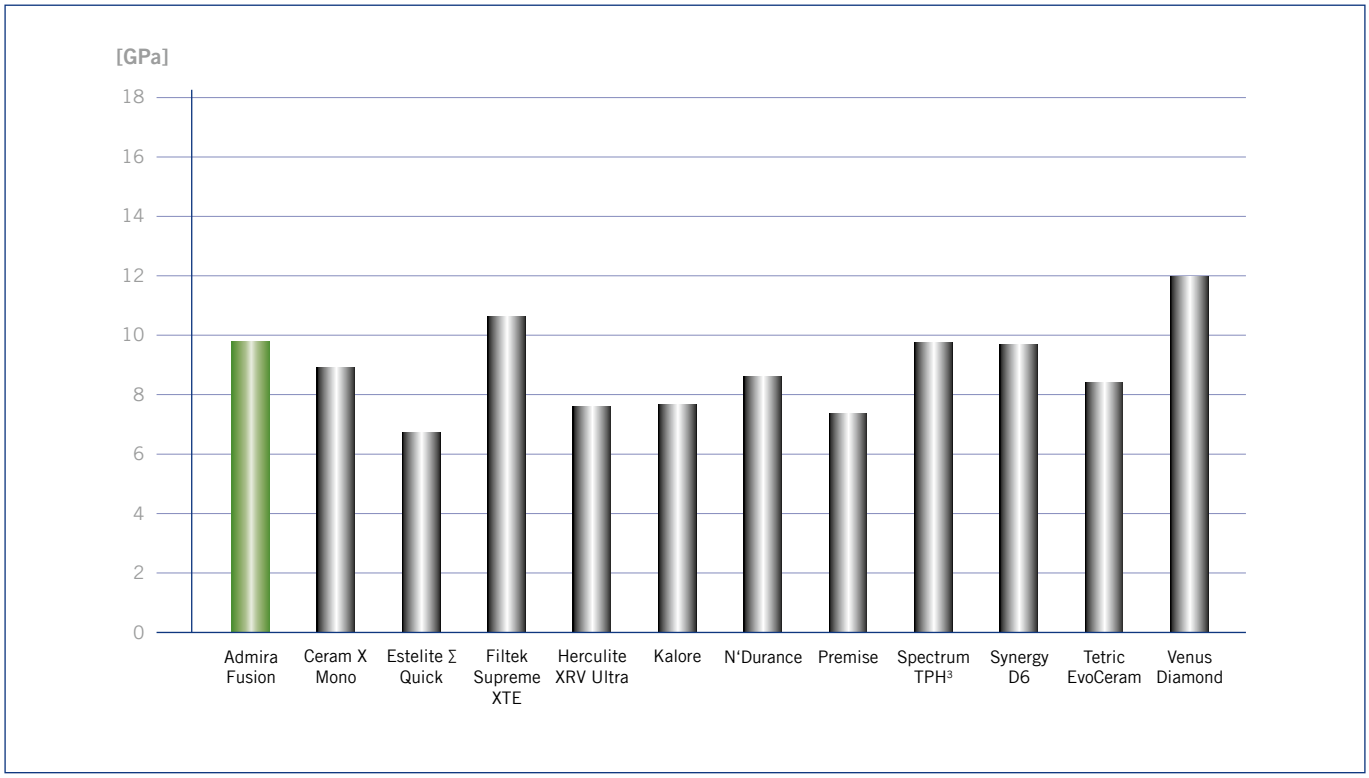
3.3. Modulus of elasticity

Measurement procedure

The modulus of elasticity was determined from the measurements of the 3-point flexural strengths by calculating the gradient in the linear range of the corresponding flexural strength measuring curve.[1]

Results

With a modulus of elasticity of 9.8 GPa, Admira Fusion is in the upper middle range of the comparison shown here.



Modulus of elasticity [GPa] of different restorative materials (VOCO 2014).

Literature

[1] Ilie N, 2004.

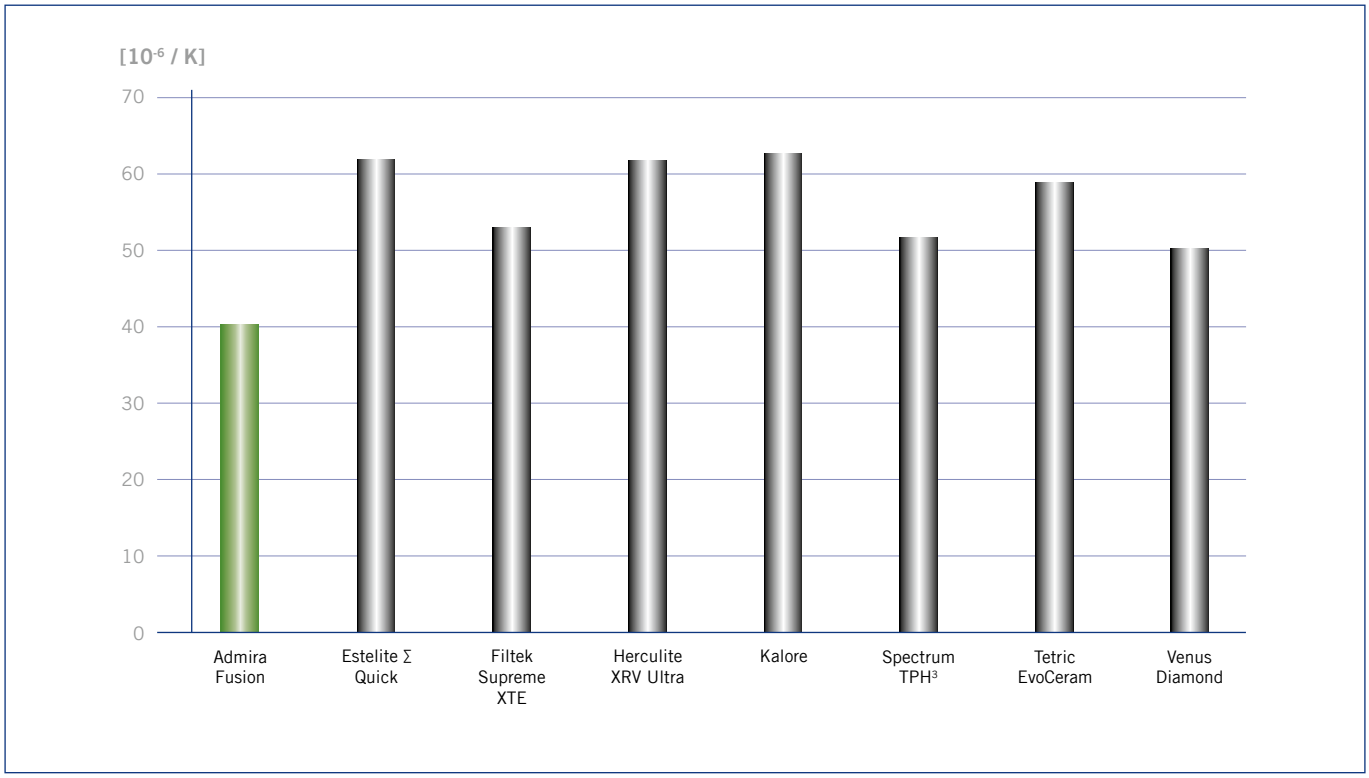
3.4. Thermal expansion coefficient

Measurement procedure

Test specimens measuring 2 × 2 × 30 mm are prepared for the measurement of the coefficient of thermal expansion α. The linear expansion of these specimens is determined with a connecting rod dilatometer in a range of 25 °C - 50 °C at a heating rate of 1 Kelvin / minute.[1]

Results

The coefficients of thermal expansion α of dentine and enamel are specified in the literature as $10.59*10^{-6}$ / K and $16.96*10^{-6}$ / K respectively.[2] Admira Fusion is not quite able to match these values, but replicates the natural expansion and contraction behaviour of natural tooth hard substance considerably better than the other materials tested. This minimises the stress imposed on the margins of restorations by the thermal expansion.



Thermal expansion coefficient α of the tested restorative materials.[1]

Literature
[1] Wolter H, 2014.
[2] Xu HC, 1989.

4. Biocompatibility of Admira® Fusion

4.1. In vitro cytotoxicity test

Measurement procedure[1]

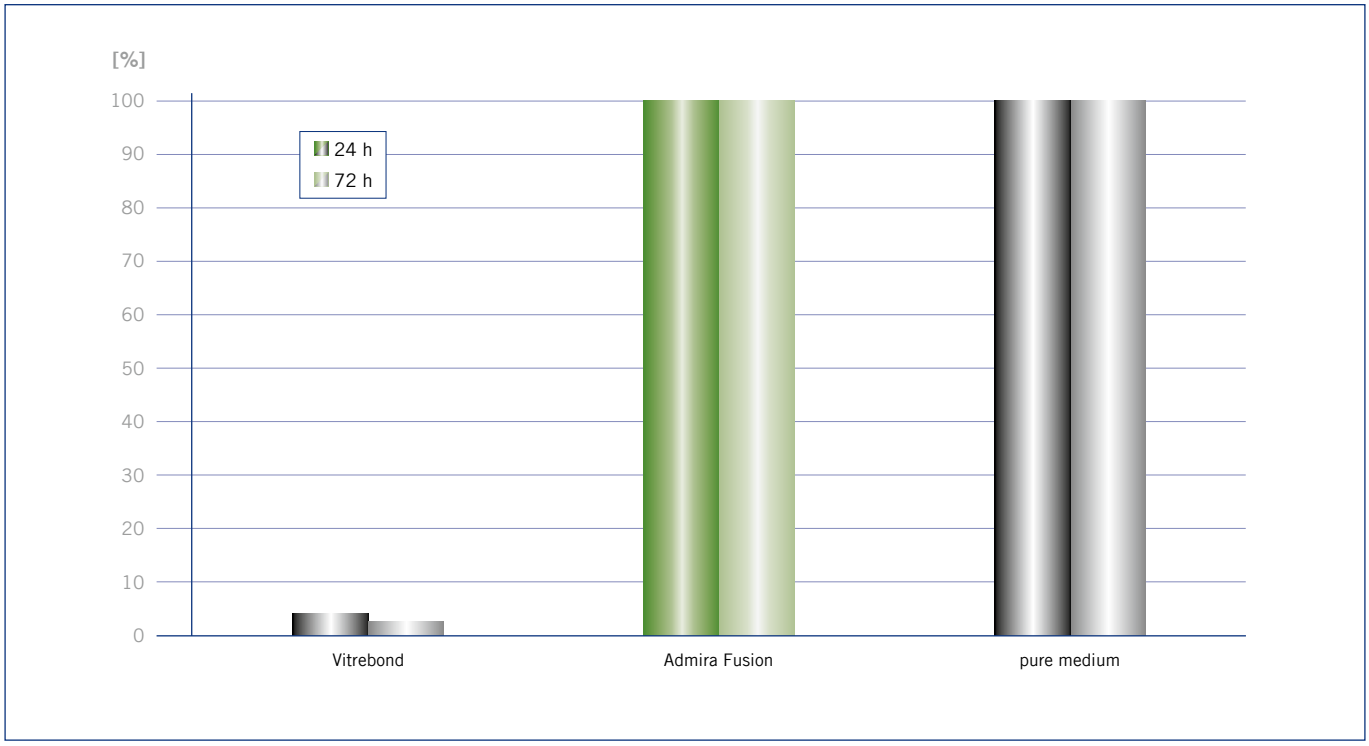
Dr. Leyhausen conducted an in vitro cytotoxicity test at Hannover Medical School. The assessment of the in vitro cytotoxicity on cell cultures was determined using extracts of the resin constituents of Vitrebond (3M ESPE) and Admira Fusion, with a pure culture medium serving as the comparison.

Results

The in vitro cytotoxicity test reported cell growth of 100 % for Admira Fusion. As such, Admira Fusion can be attributed with excellent biocompatibility.[2]

Cytotoxicity scale[3]

Scale	Proliferation [%] (with ref. to control)	Interpretation
0	100 - 81	Not cytotoxic
1	80 - 71	Slightly cytotoxic
2	70 - 61	Moderately cytotoxic
3	60 - 0	Highly cytotoxic



In vitro cytotoxicity test of Admira Fusion, pure culture medium, Vitrebond (3M ESPE).[2]

Literature

[1] Leyhausen G, 1998.
[2] Leyhausen et al., 2015.
[3] ISO 10993-5, International Organisation for Standardisation.

4.2. Examination of the resin matrix

Light-curing restorative materials are cured using a suitable light-curing unit. This induces a polymerisation reaction, with the reaction rate in this type of reaction being a maximum of 70 %. To what extent residual monomers remain in the cured composite depends on the type of monomers employed. The rule of thumb applies that the more linking units a monomer has, the lower the probability that residual monomers will remain following curing. The way to ensure a lower proportion of residual monomers, or even better, to rule out the presence of residual monomers in the cured composite, is to employ monomers with a lot of linking units. Analytical methods such as gas chromatography and high performance liquid chromatography can be used to verify the remaining residual monomers.

4.2.1. Gas chromatography / high performance liquid chromatography

Measurement procedure[1] [2]

The test specimens were immersed uncured and cured in an ethanol solution (10 ml) overnight at 37 °C. Samples were then taken from these solutions and the resin matrix broken down into the individual components by means of gas chromatography (GC) and high performance liquid chromatography (HPLC). Gas chromatography was used to detect resin monomers of a relatively small size and low molecular weight, whereas high performance liquid chromatography was employed to detect resin monomers with a relatively large size and high molecular weight.

Results[3]

The gas chromatography spectrum in Figure 1 shows clearly that no methacrylate monomers with a low molecular weight are used in uncured Admira Fusion. The first four measurement signals, between 0 and 5.5 minutes, are signals which can be attributed to the eluate used. In addition, the claim that no conventional methacrylate monomers are used is confirmed yet again by the analysis of the already cured Admira Fusion test specimen (see Figure 2). Conventional monomers such as Bis-GMA, TEGDMA, GlyDMA and HEMA can be detected with this measuring method, as is the case in the comparative spectrum of the conventional composite shown as an example in Figures 3 and 4. In this case, conventional methacrylate monomers can be detected in both the uncured and the cured specimens of the composite. The curing of the composite lowers the concentration of unreacted, freely available monomers significantly, as can be seen from the considerably lower signals in the spectrum (Figure 4). The conventional monomers Bis-GMA, at 42.5 minutes, GlyDMA, at 14.2 minutes, and HEMA, at 9.2 minutes, among others, can be attributed to these signals.

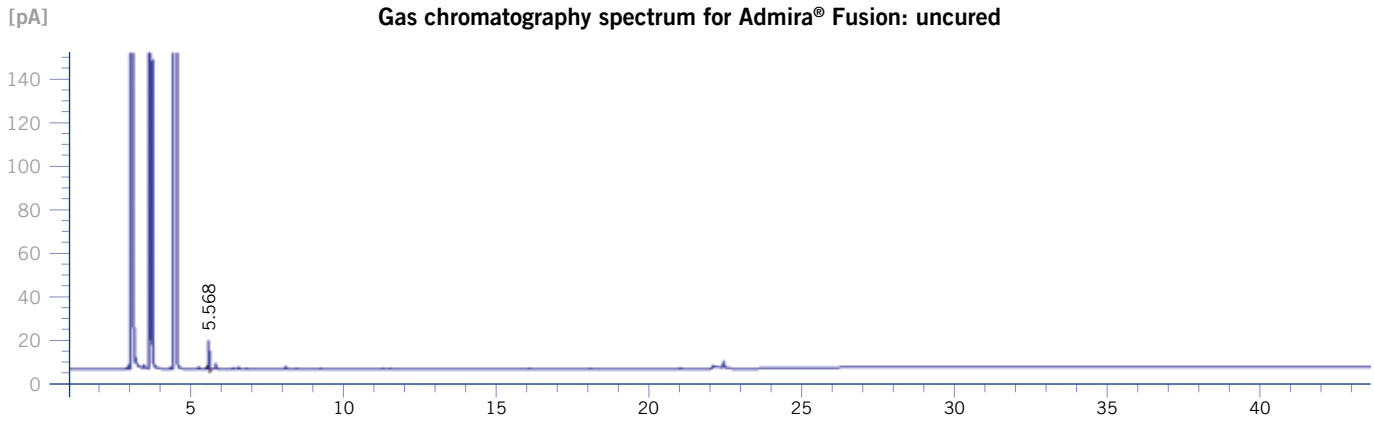


Figure 1: GC spectrum of uncured Admira Fusion, measured internally, VOCO 2015.

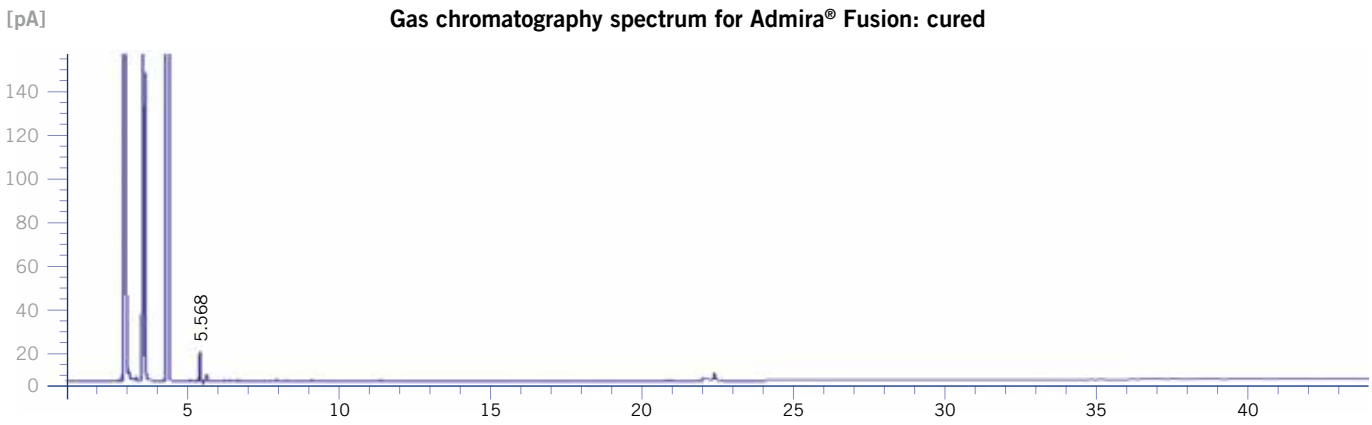


Figure 2: GC spectrum of cured Admira Fusion, measured internally, VOCO 2015.

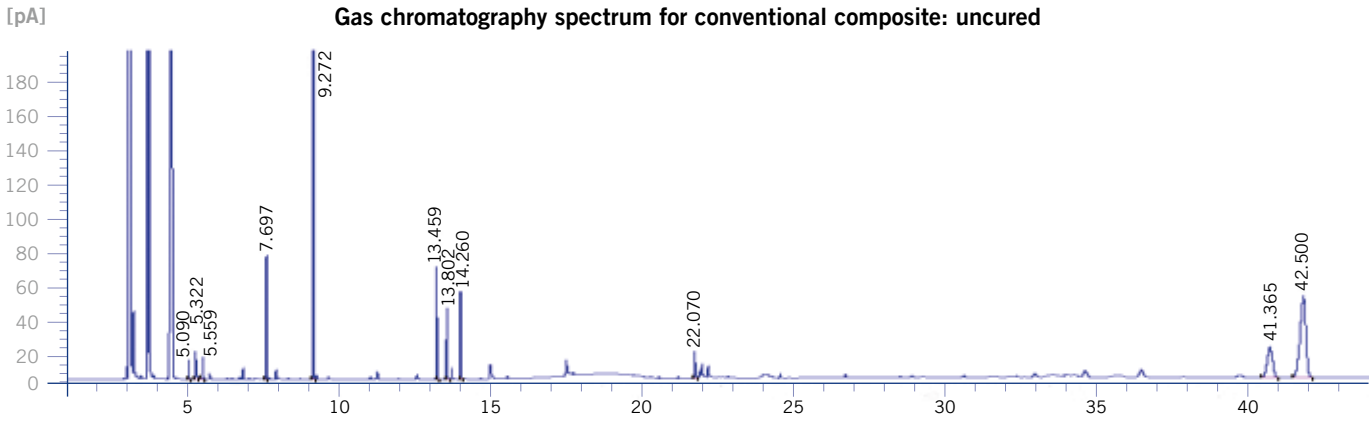


Figure 3: GC spectrum of uncured conventional composite, measured internally, VOCO 2015.

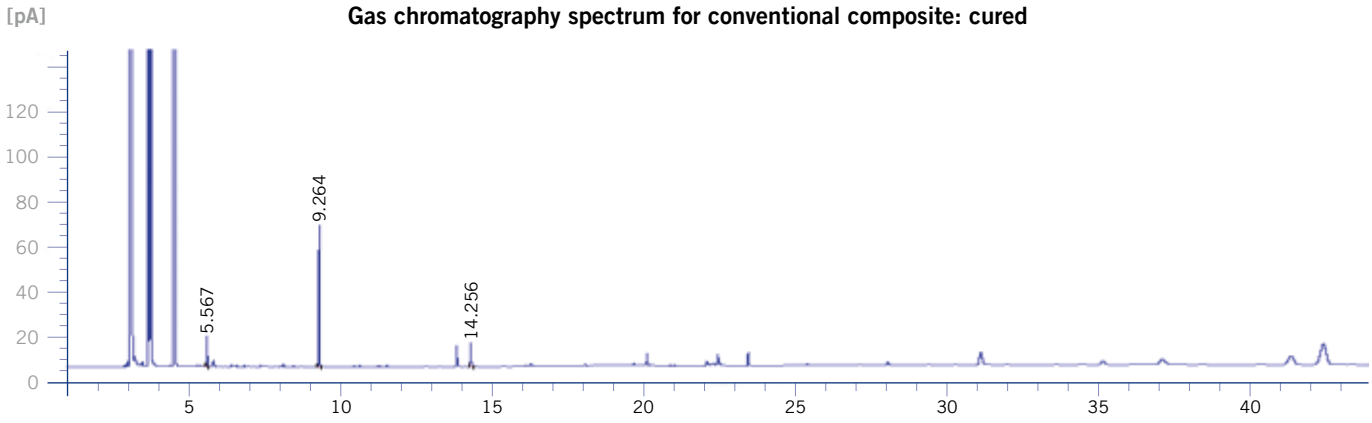


Figure 4: GC spectrum of cured conventional composite, measured internally, VOCO 2015.

The high performance liquid chromatography makes it possible to separate materials into their components when their individual components are much larger and heavier than those previously indicated which were analysed using the gas chromatography method. Figure 5 illustrates that monomers of the ORMOCER® resin matrix can be detected in the uncured Admira Fusion. This is particularly evident between minutes 34 and 40. They are large, pre-condensed molecules of an inorganic matrix which are functionalised with methacrylate groups. Following curing of Admira Fusion, testing was carried out again to determine whether these monomers can be washed out of the ORMOCER® resin matrix. Figure 6 shows clearly that no residual monomers were detected. This is down to the use of the multifunctional ORMOCER® resin components, which allow effective cross-linking within the polymer.

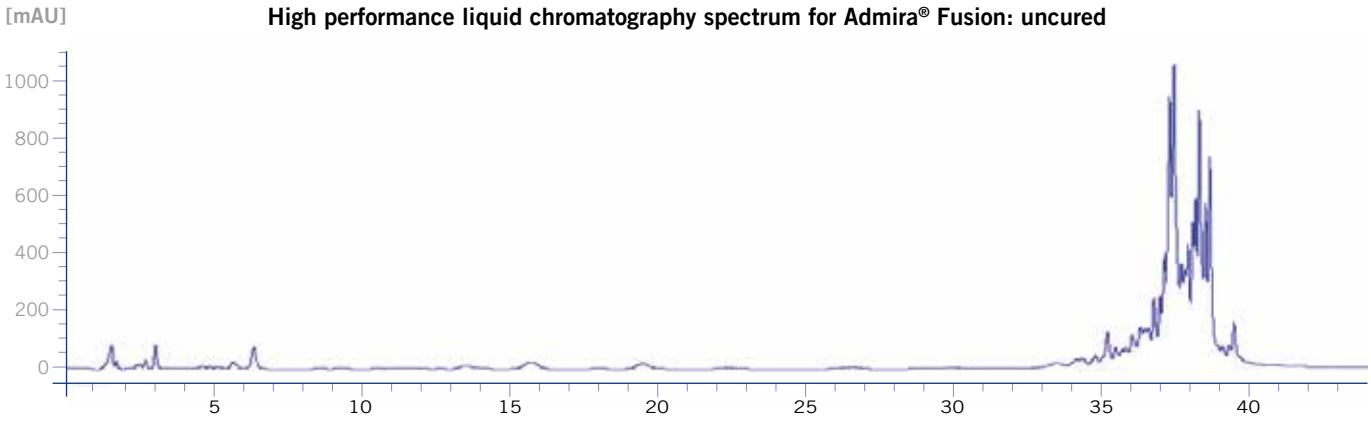


Figure 5: HPLC spectrum of uncured Admira Fusion, measured internally, VOCO 2015.

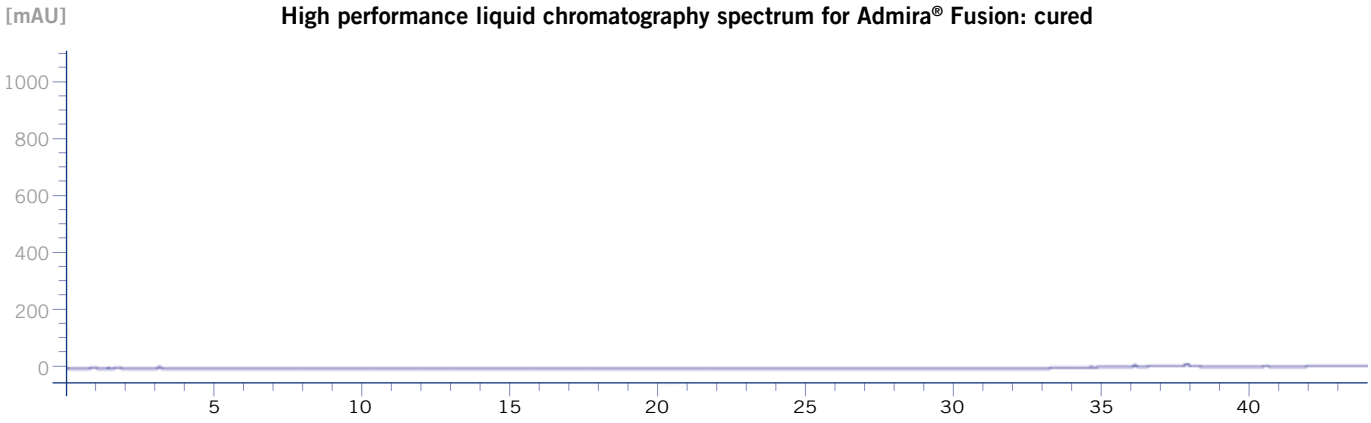


Figure 6: HPLC spectrum of cured Admira Fusion, measured internally, VOCO 2015.

Literature

[1] Kolb B, 2003.
[2] Meyer VR, 2009.
[3] R&D VOCO GmbH, 2015.

5. Physical parameters for strength of Admira® Fusion

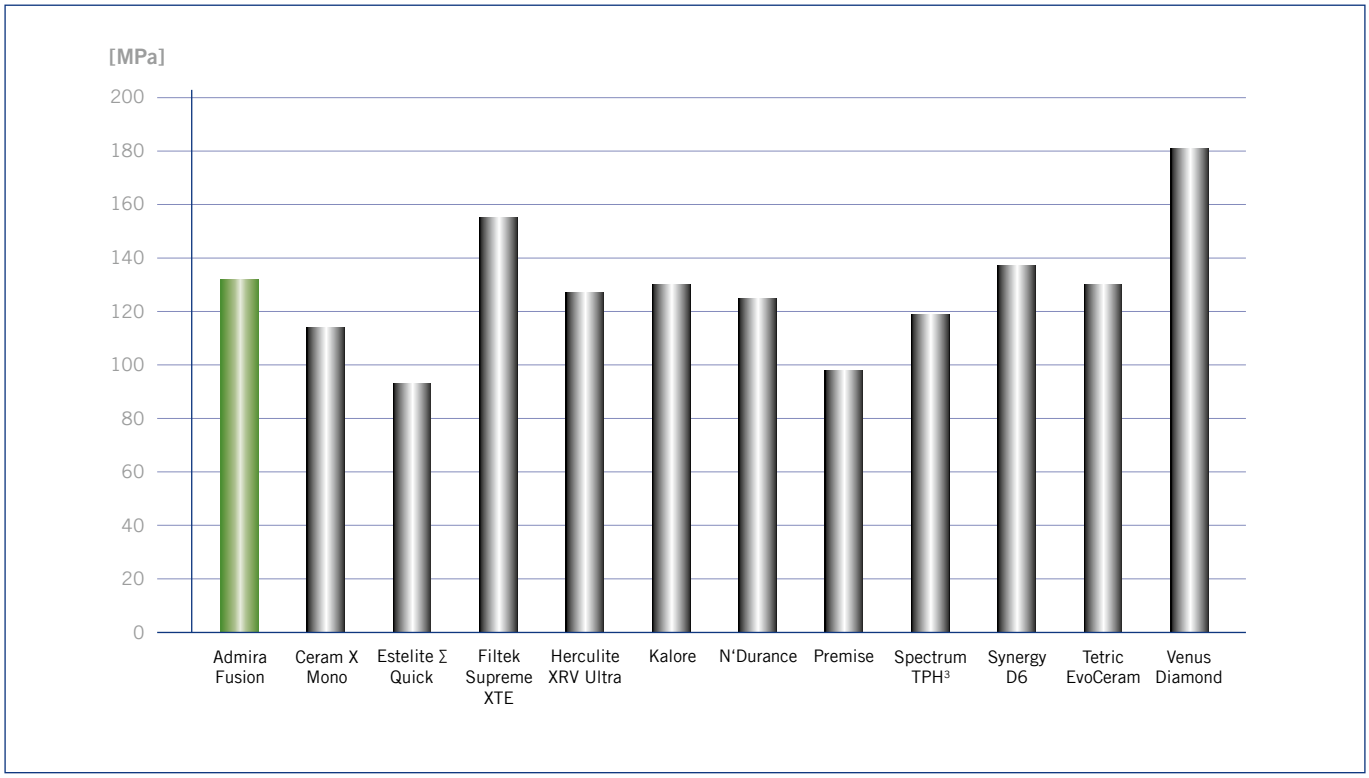
5.1. 3-point flexural strength

Measurement procedure

The procedure for determining the 3-point flexural strength is described in ISO 4049.[1] In accordance with the standard, test specimens measuring 2 × 2 × 25 mm were prepared and subjected to a total of 0.75 ± 0.25 mm / min on a force test stand. The test specimens lie on two rods whilst the force is applied centrally from above via a third rod. The specified flexural strength is the value at which the test specimen breaks. The ISO standard specifies a minimum value of 80 MPa for light-curing, composite-based restorative materials.

Results

Admira Fusion offers a flexural strength of 132 MPa. It is interesting to compare this with dentine, which is ascribed a flexural strength of 165.6 MPa in the literature.[2]



3-point flexural strength [MPa] of the tested restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

[2] Jameson MW, 1993.

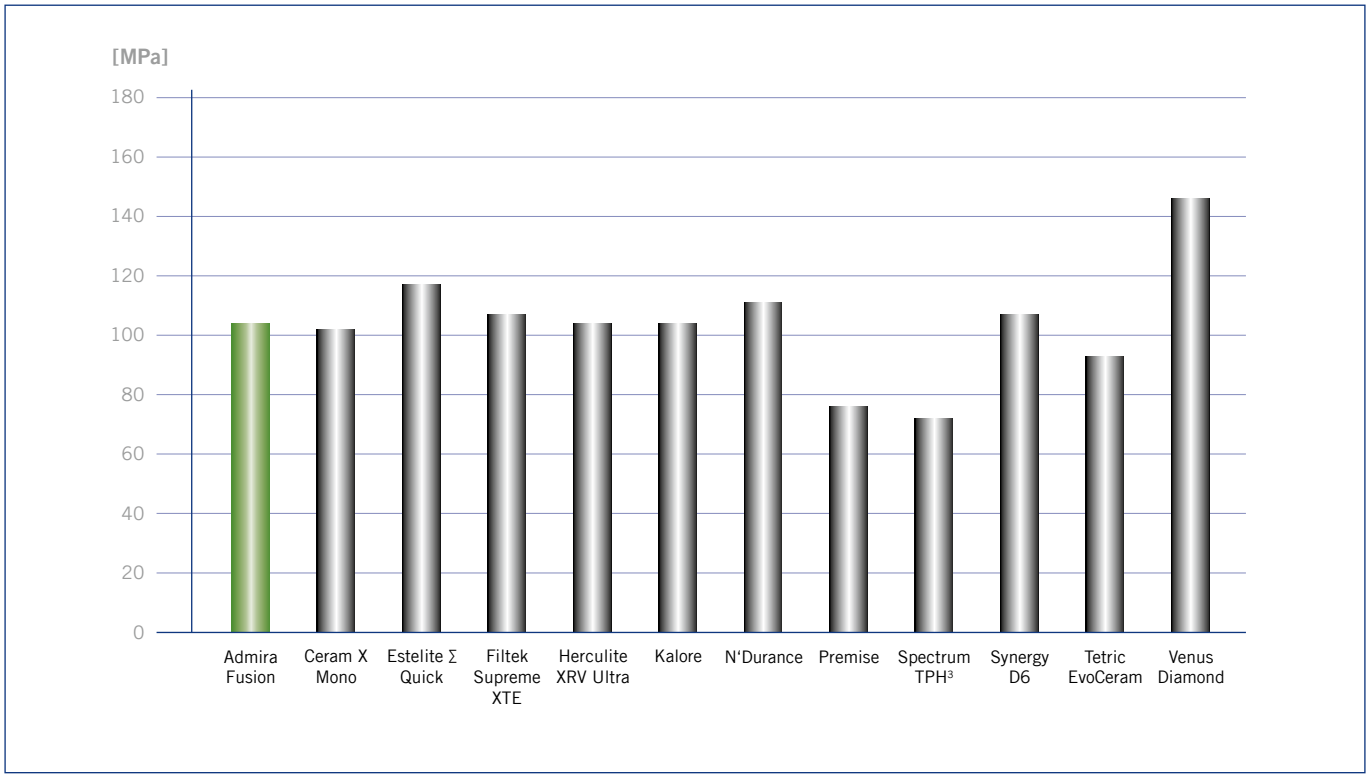
5.2. 3-point flexural strength after thermocycling

Measurement procedure

Materials are subjected to a process known as thermocycling to simulate the natural ageing process. In this procedure, the test specimens are alternately heated to 55 °C and cooled down to 5 °C in an aqueous medium. This cycle was completed 3,000 times in total in this measurement. The 3-point flexural strength is then determined as described in 5.1.[1]

Results

As is to be expected, the flexural strength values are somewhat lower after thermocycling than before the artificial ageing. Compared with the initial value (before thermocycling), Admira Fusion still has a very good 3-point flexural strength in comparison, at 104 MPa.



3-point flexural strength after thermocycling [MPa] of the tested restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

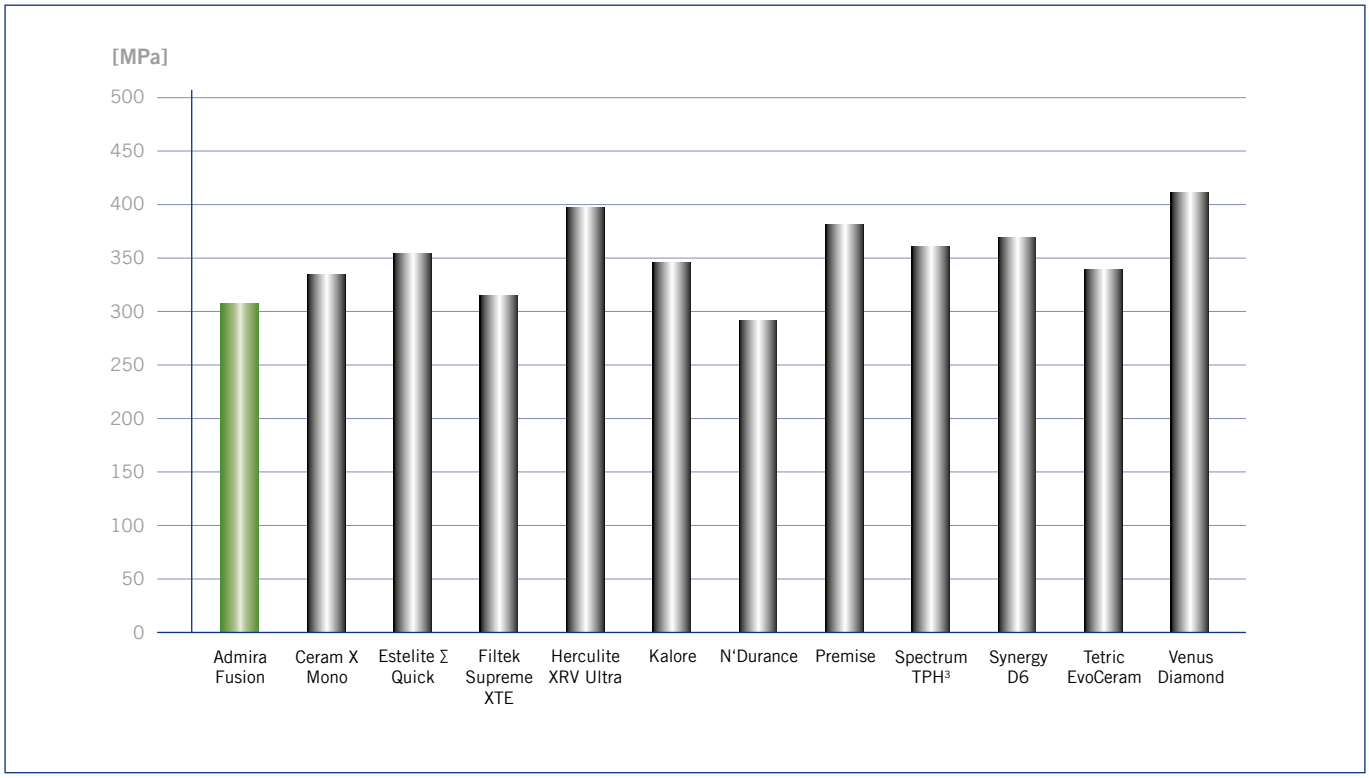
5.3. Compressive strength

Measurement procedure

The compressive strength was measured in the same way as the procedure described in ISO 9917 for testing cements.[1] This was done by producing 6 mm high cylinders with a diameter of 3 mm. The test specimen was then subjected to a force of 50 ± 16 N / min until it failed under the applied loading. The load under which the test specimen breaks is designated as the compressive strength.

Results

In this test, Admira Fusion displayed a compressive strength of 307 MPa, similar to that of dentine (297 MPa).[2]



Compressive strengths [MPa] of all the tested restorative materials (VOCO 2014).

Literature

[1] ISO 9917, International Organisation for Standardisation.

[2] Craig RG, Peyton FA, 1958.

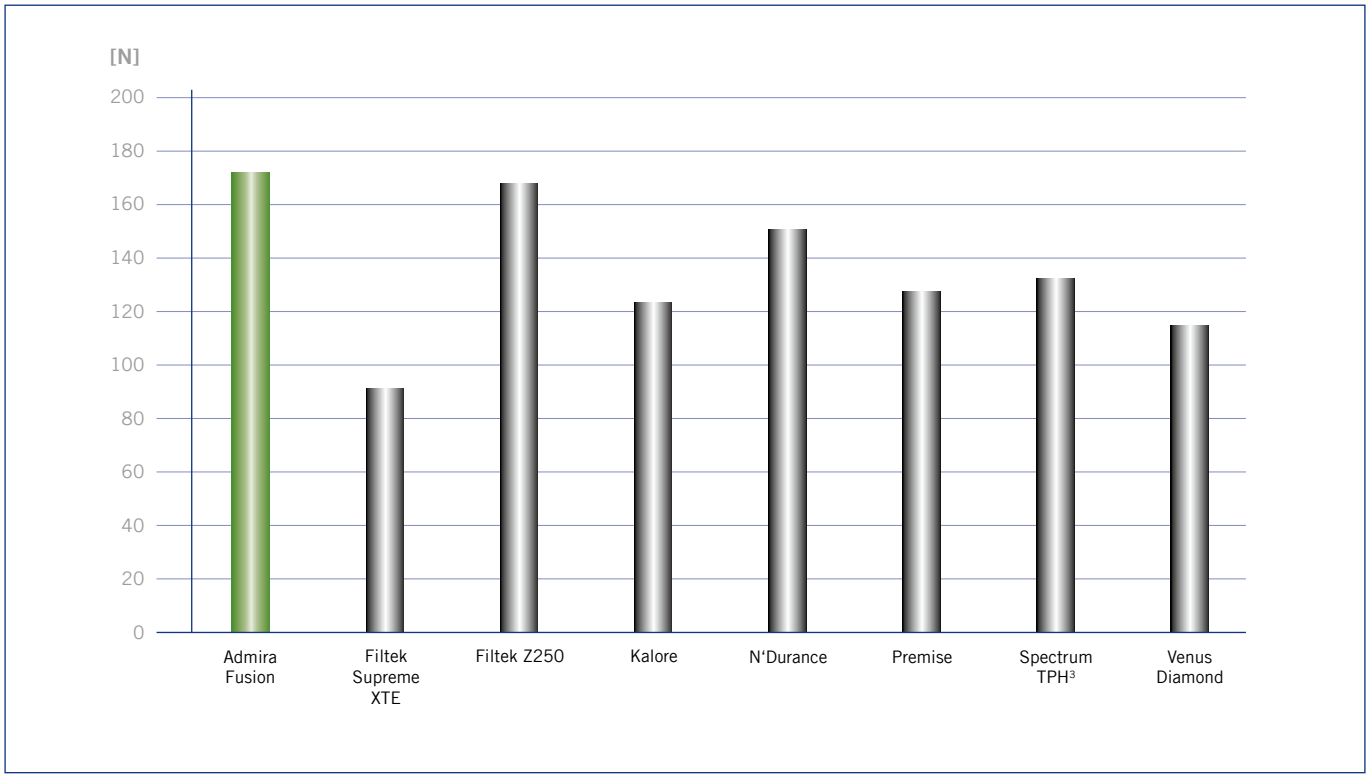
5.4. Edge strength

Measurement procedure[1]

The edge strength was determined with a special measuring device (CK10, Engineering Systems) at the University of Manchester.[2] Test specimens with a diameter of 12 mm and a height of 2.5 mm were produced and then immersed in water for 7 days at 37 °C. The pressure was applied with a diamond tip 0.5 mm from the edge at a speed of 1 mm / min. Chipping and complete fracture were recorded as faults. The detection was performed using an acoustic sensor.

Results

Admira Fusion's edge strength of 171.9 N was the best value recorded in the study.



Edge strength [N] of various restorative materials.[2]

Literature
[1] Watts DC, Silikas N, 2008.
[2] Watts DC, Silikas N, 2014.

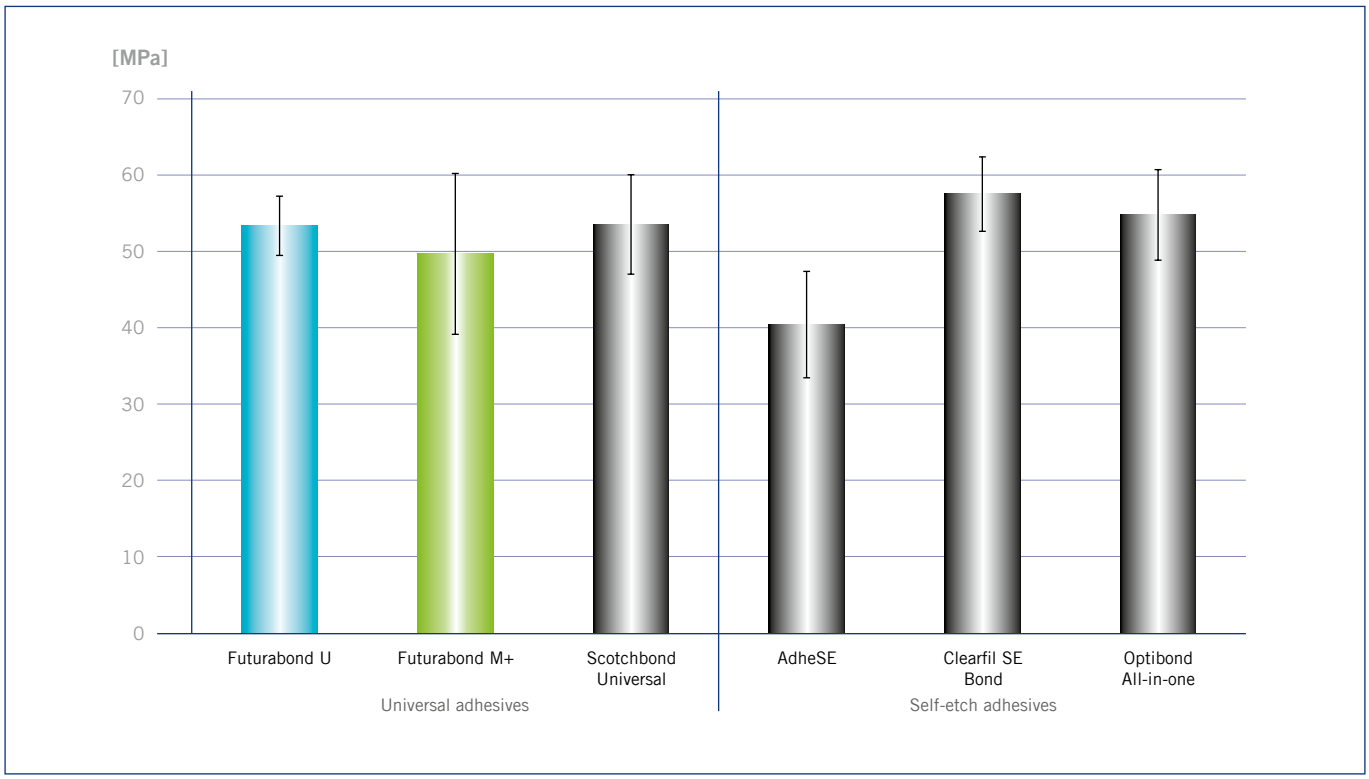
5.5. Adhesion values on dentine

Measurement procedure

The following study by Giannini et al. was conducted at the Federal University of Campinas (Brazil).[1] The adhesive systems represented in the graph below were applied to correspondingly prepared dentine test specimens in the self-etch mode in accordance with the manufacturer's instructions. Admira Fusion was used as the restorative material for all the tests. It was applied to the respective adhesive layer and light-cured in accordance with the manufacturer's instructions. The test specimens were then immersed in water for 24 hours, after which the tensile bond strength tests were performed with a universal testing machine.

Results

Admira Fusion achieved impressive micro-tensile bond strength values on dentine with all the adhesive systems employed in the test. The long-term integrity of fillings and restoration margins depends on the strength of the bond between the tooth hard substance and adhesive, and this is of course determined by the quality of the adhesive system, among other factors. However, the compound produced between the adhesive and the restorative material is just as important for the long-term integrity of restorations. The measured values are an impressive testament to the compatibility with the adhesive systems tested here. The universal compatibility applies to all the main adhesive systems on the market, irrespective of whether they are self-etch, total etch or universal adhesives.



Micro tensile bond strength values [MPa] of Admira Fusion on dentine with different adhesives.[1]

Literature

[1] Giannini et al., 2015.

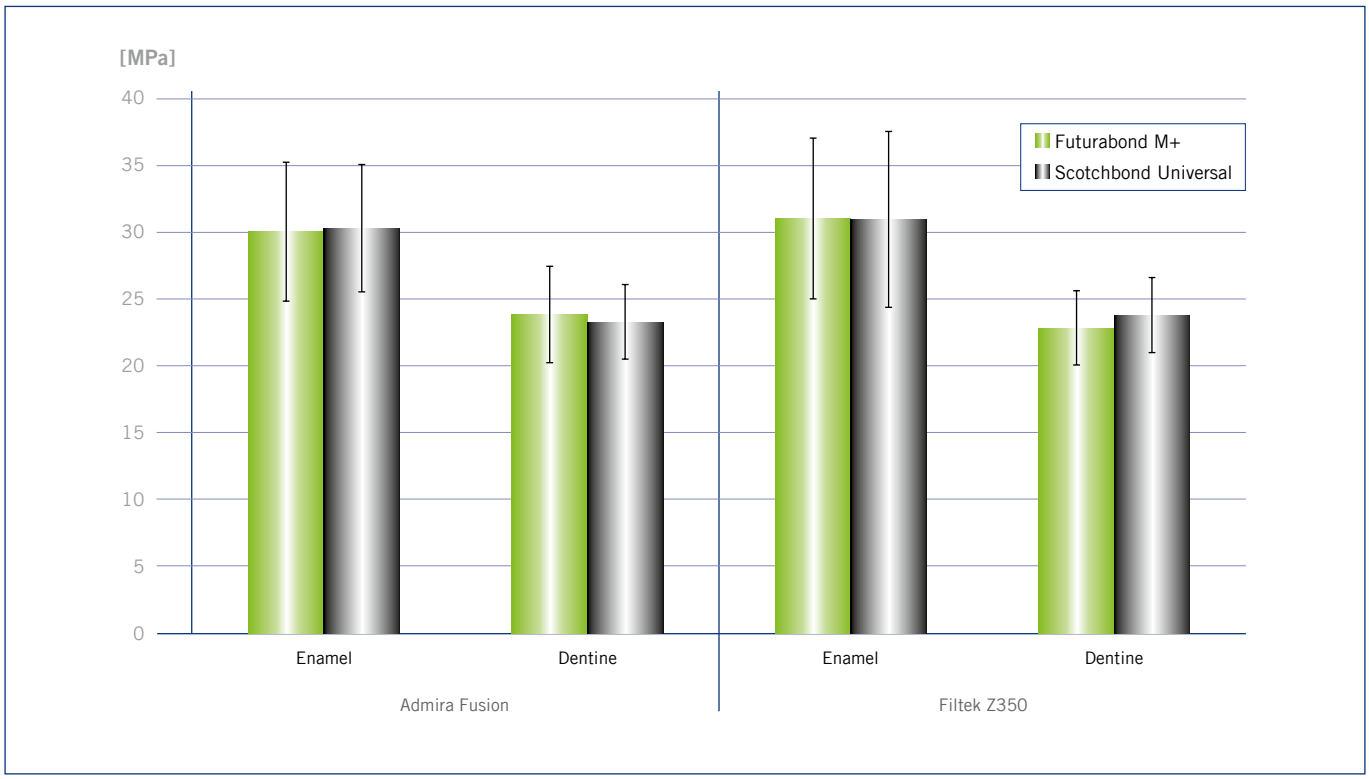
5.6. Adhesion values on enamel and dentine

Measurement procedure[1]

The study was conducted at the University of São José dos Campos (Brazil) under the supervision of Prof. Torres. Following appropriate storage, 80 freshly extracted bovine teeth were cleaned, prepared, divided into two groups (n = 40) (enamel and dentine) and specifically prepared. The test specimens were embedded in an acrylic resin matrix and divided into two subgroups (n = 20) for each composite restorative material and adhesive system (Futurabond M+ (VOCO) and Scotchbond Universal (3M ESPE)) respectively. Each universal adhesive system was applied in the self-etch mode in accordance with the manufacturer's instructions. A 2 mm layer of the restorative material (Admira Fusion (VOCO) or Filtek Z350 (3M ESPE)) was then applied to the test specimen with the help of a silicone matrix and light-cured for 20 seconds. After the matrix was removed, the block was light-cured again for a further 20 seconds. The tensile bond strength measurement was performed with a universal testing machine (DL200MF, Emic).

Results

The tensile bond strength values depicted in the graph do not differ significantly for either the tested restorative materials or adhesive systems. Both the universal adhesives employed display excellent adhesion values both in combination with the ORMOCER®-based restorative material Admira Fusion and with the methacrylate-based restorative material Filtek Z350.



Tensile bond strength values [MPa] of Admira Fusion and Filtek Z350 on enamel and dentine with different adhesives.[1]

Literature

[1] Torres et al., 2015.

6. Physical parameters regarding surface properties of Admira® Fusion

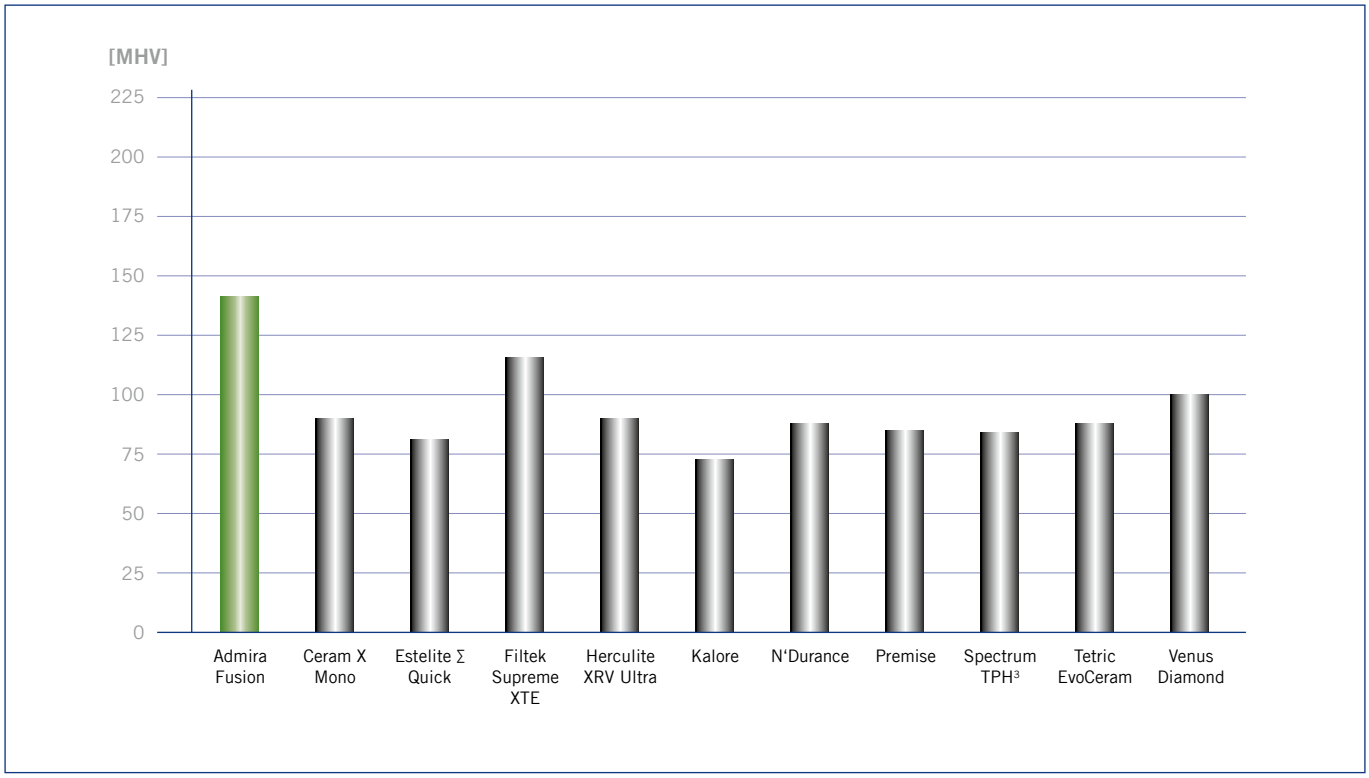
6.1. Surface hardness

Measurement procedure

The surface hardness of Admira Fusion was determined in a study conducted at the University of Rostock by measuring the microhardness (Vickers) of light-cured test specimens measuring 2 × 2 mm.[1] First of all, the surface was treated with sandpaper. A standardised diamond prism was then applied to the test specimen with a force of 1 N and a penetration velocity of 0.2 N / second. After a retention period of 5 seconds, the diamond was removed and the impression left in the test specimen was measured. The Vickers microhardness was calculated from the dimensions of the impression.

Results

Admira Fusion revealed a very high surface hardness of 141 MPa in this test. This high value promises long-term resistance to surface abrasion and a high dimensional stability of the occlusal surface.



Surface hardness [MHV] of different composite materials.[1]

Literature

[1] Behrend et al., 2014.

7. Physical parameters for behaviour of Admira® Fusion in an aqueous environment

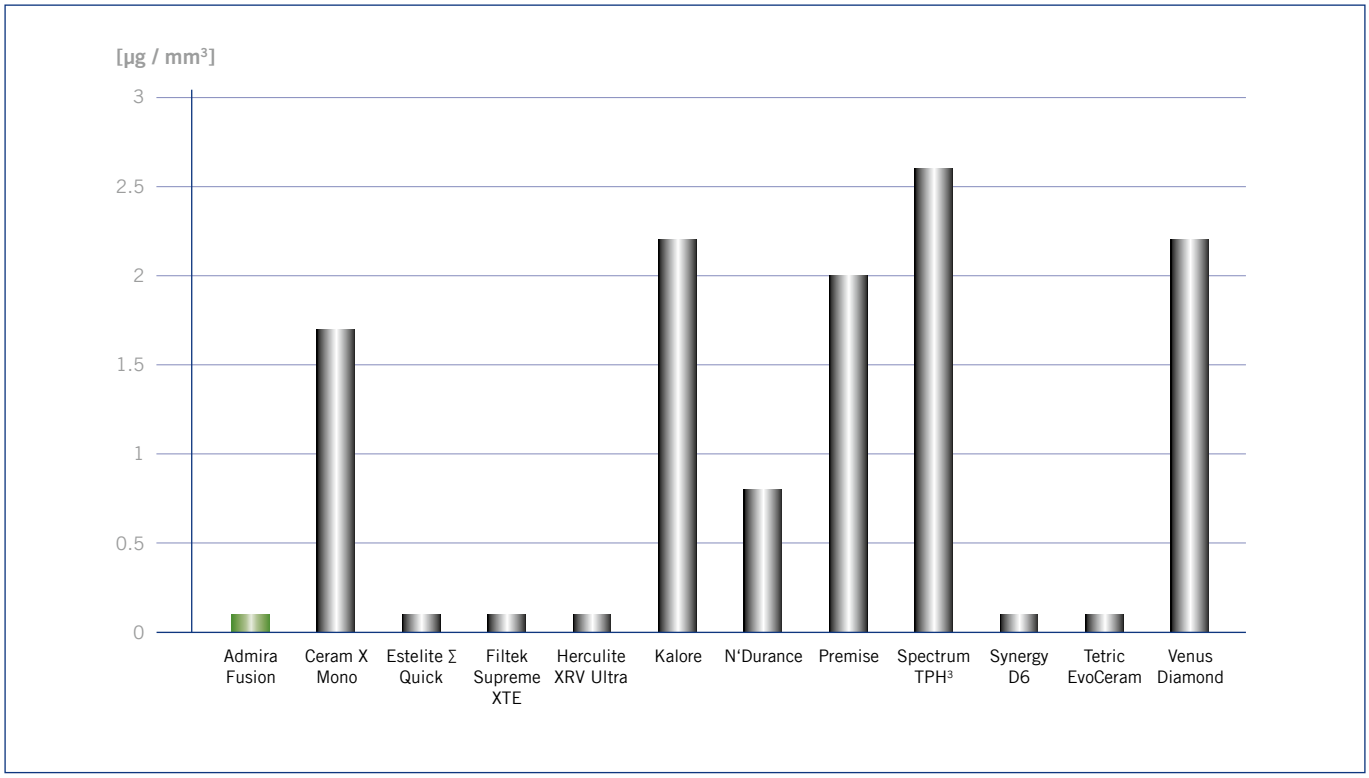
7.1. Solubility in water

Measurement procedure

Admira Fusion's solubility in water was determined in accordance with the ISO 4049 standard.[1] Test specimens with a diameter of 15.0 ± 0.1 mm and a height of 1.0 ± 0.1 mm were light-cured. After determining the starting weight, the test specimens were immersed in water for 7 days at 37 °C. They were then removed, rinsed off with water and dabbed dry until the surface showed no more signs of moisture. After being stored in a vacuum at 37 °C, the weight was measured again and compared with the starting weight in order to calculate the water solubility. The ISO 4049 standard specifies a water solubility of ≤ 7.5 µg / mm³.

Results

Admira Fusion stands out with an extremely low solubility of < 0.1 µg / mm³. Long-term destabilisation caused by washing-out processes during the lifetime of the restoration is therefore highly unlikely.



Water solubility [µg / mm³] of different restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

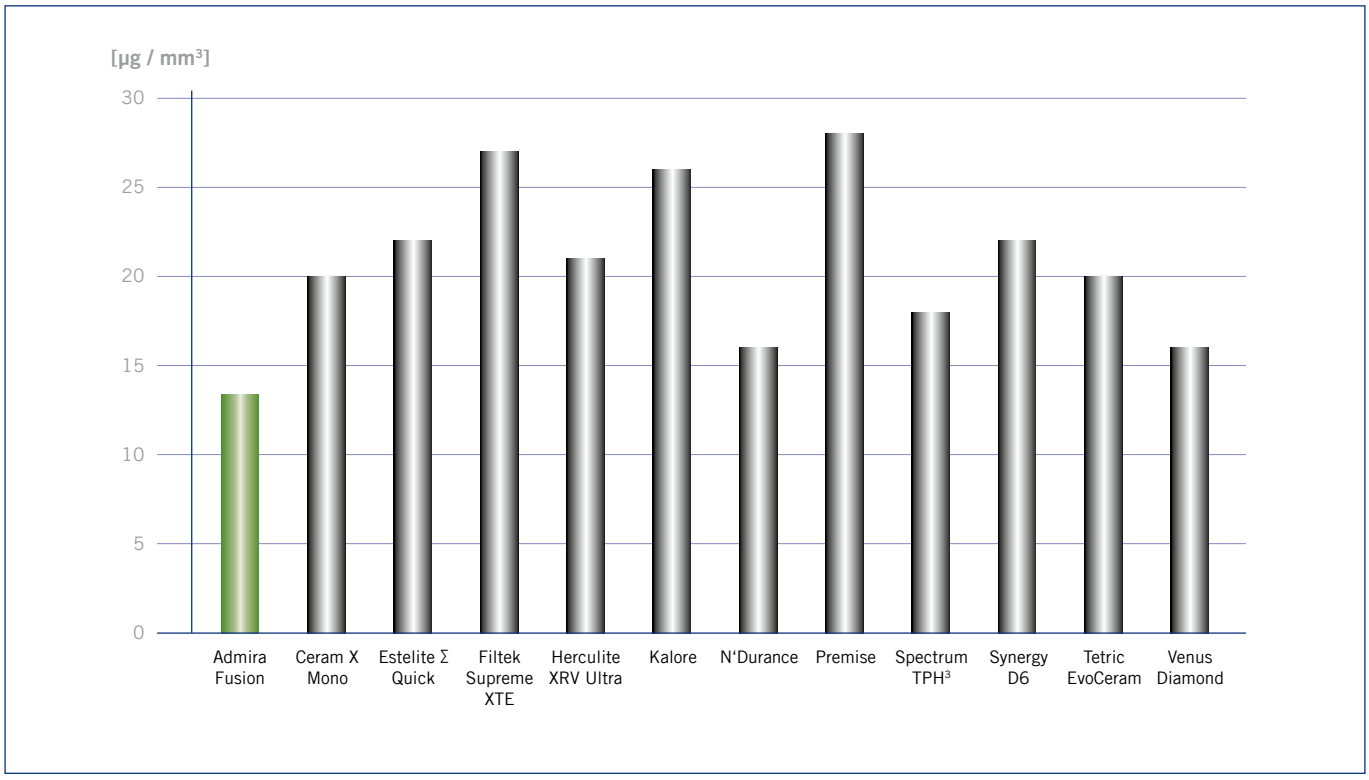
7.2. Water absorption

Measurement procedure

Admira Fusion's water absorption was determined in accordance with the ISO 4049 standard.[1] Test specimens of the tested composites with a diameter of 15.0 ± 0.1 mm and a height of 1.0 ± 0.1 mm were light-cured. After determining the starting weight, the test specimens were immersed in water for 7 days at 37 °C, before being removed again, rinsed off with water and dabbed dry until the surface showed no more signs of moisture. The test specimens were shaken in the air for 15 seconds and weighed 1 minute after being removed from the water. This value was then used to determine their water absorption. The ISO 4049 standard specifies a water absorption value of ≤ 40 µg / mm³.

Results

A comparison of the water absorption values reveals that Admira Fusion has one of the lowest values among the restorative materials tested here, at just 13.4 µg / mm³. This low level of water absorption indicates low swelling behaviour of the restoration and is thus a sign of long-term integrity and colour stability.



Water absorption [µg / mm³] of the studied restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

8. Handling properties of Admira® Fusion

8.1. Light-curing times

The photoinitiator in Admira Fusion is camphor quinone, which can be activated with all commercially available light-curing units. The following curing times apply, depending on the opacity of the individual shades and the output of the lights:

LED and halogen lamps with a minimum power output of 500 mW / cm²

20 s: A1, A2, A3, A3.5, A4, B1, B2, B3, C2, D3, BL, Incisal, GA3.25

40 s: OA1, OA2, OA3, OA3.5, GA5

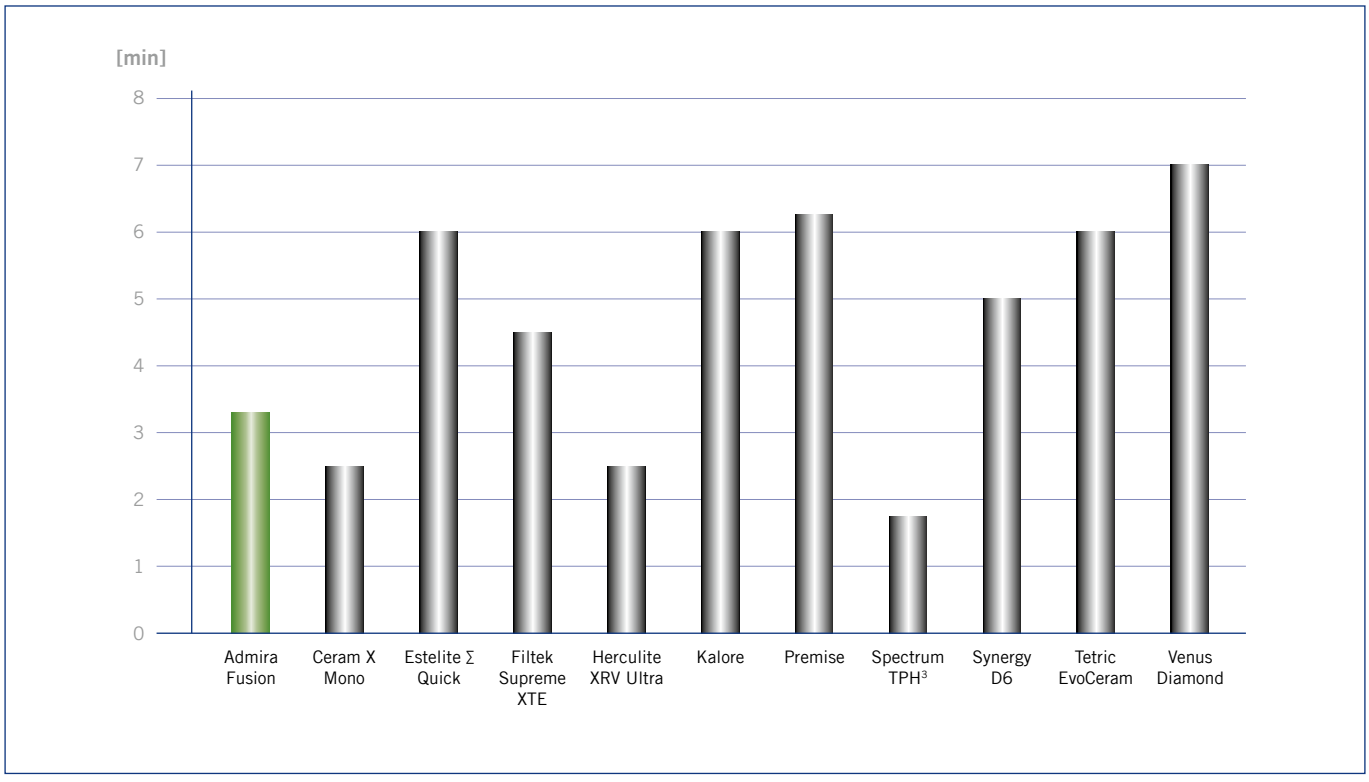
8.2. Resistance to ambient light

Test procedure

The resistance to natural light or ambient light was determined in accordance with the ISO 4049 standard.[1] Small balls of the material weighing around 30 mg were exposed to a defined level of ambient light (8000 ± 1000 lux). At 5 second intervals, a ball was compressed to a thin layer between two glass plates. As soon as the material displayed cracks or inhomogeneity, its resistance to daylight was considered to have been exceeded.

Results

Resistance to natural light of 3 minutes and 18 seconds allows the user of Admira Fusion to place the restoration in line with standard clinical practice.



Determined resistance to ambient light [min] of different restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

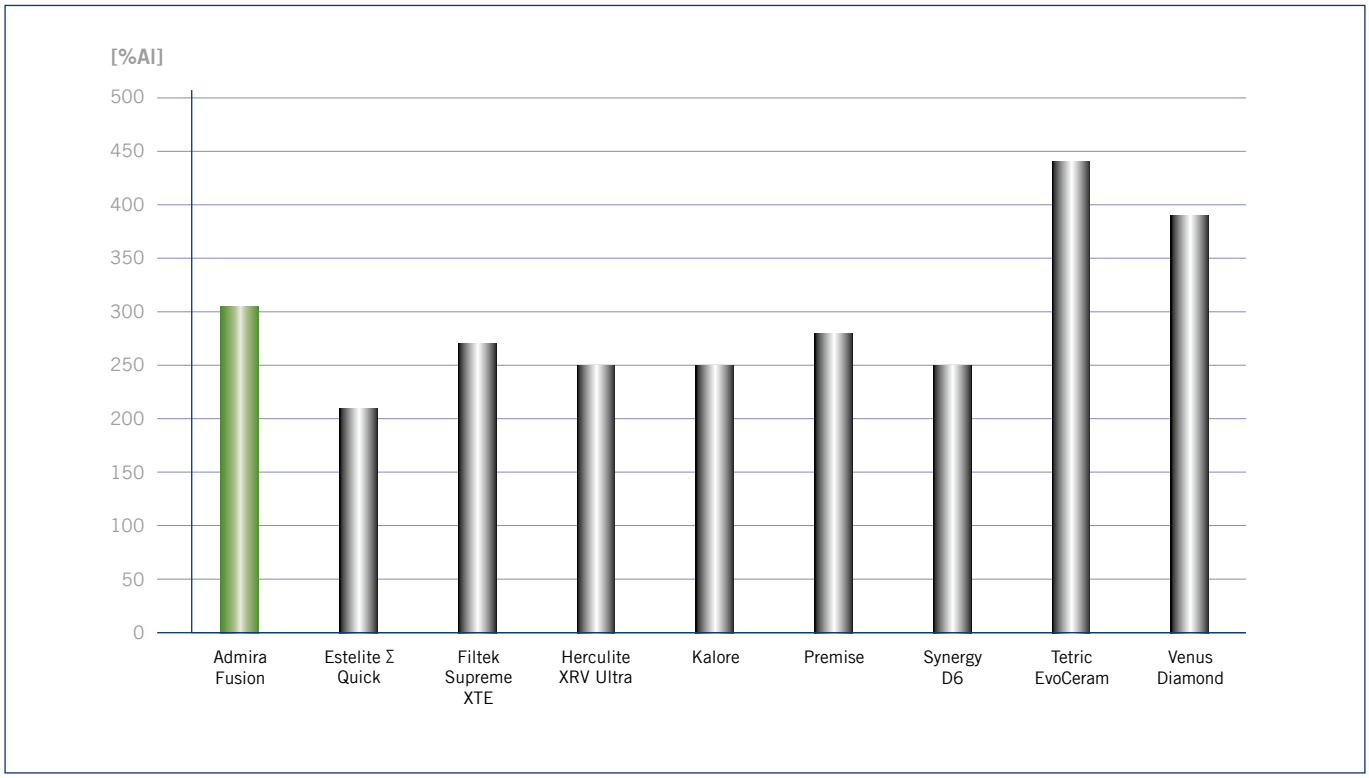
8.3. Radiopacity

Test procedure

To determine the radiopacity, test specimens with a diameter of 15 mm and a height of 2 mm were produced and then an X-ray was taken (7 mA; 60 kV; 0.04 s). A staircase-shaped aluminium body was used for comparison. For the measurements, the height of the aluminium steps and the thickness of the test specimens were determined with a precision of 0.01 mm. In addition, the grey values were also determined for both. These values were then used to calculate the radiopacity in aluminium equivalents by means of linear regression.[1]

Results

Admira Fusion displays a radiopacity of 305 %Al. This guarantees excellent visibility of even thin layers in X-rays, which helps the practitioner in the documentation of findings.



Values [%Al] for describing the radiopacity of restorative materials (VOCO 2014).

Literature

[1] ISO 4049, International Organisation for Standardisation.

9. Clinical studies

9.1. Clinical results of Class II restorations after 6 months

Aim

The 24-month study shows the clinical evaluation of Class II restorations fabricated with either the nanohybrid ORMOCER® restorative material Admira Fusion (VOCO) or the nanohybrid composite GrandioSO (VOCO).[1]

Study design

A total of 30 patients were selected, who received both a Class II restoration with Admira Fusion and a Class II restoration with GrandioSO. Very deep cavities were firstly filled with a calcium hydroxide cement (Dycal, Dentsply) and then with a thin layer of a conventional glass ionomer cement. Deep cavities were lined with a conventional glass ionomer cement. Futurabond M+ was used as the adhesive in all cases and applied in the self-etch mode in accordance with the instructions for use. The restorative materials were applied in the Class II cavities in increments and light-cured in accordance with the manufacturer's instructions. The clinical evaluations of the restorations were performed by two independent experts. The FDI criteria published by Hickel were used for the evaluation criteria.[2][3] The intervals chosen for the evaluations were: initial (after 7 days), after 6 months, after 12 months and after 24 months.

Recall overview

Restorative material used	Number of assessed restorations	
	Initial	**6 months**
Admira Fusion	30	30
GrandioSO	30	30
Total restorations	60	60

Results

The intermediate results collected after the first recall (6 months) paint a thoroughly positive picture for Admira Fusion and also GrandioSO. Figures 1 - 3 show the individual evaluation criteria based on aesthetic, functional and biological parameters. Both restorative materials scored highly with excellent results, which are largely thanks to their special chemical composition.

Literature

[1] Torres CRG, 2015.
[2] Hickel et al., 2007.
[3] Hickel et al., 2010.

Figure 1: Aesthetic parameters.[1]

Literature

[1] Torres CRG, 2015.

Figure 2: Functional parameters.[1]

Literature

[1] Torres CRG, 2015.

Figure 3: Biological parameters.[1]

Literature

[1] Torres CRG, 2015.

9.2. Clinical Evaluation of ORMOCER® Bulk Fill Materials in Class II cavities restored by either incremental or Bulk fill techniques, 6 months results

Aim

The 48-month study investigates the question of whether the layer thickness affects the quality of the restorations (class II) produced. The restorations were fabricated with Admira Fusion x-tra, on the one hand with layers of 2 mm thickness, on the other hand of 4 mm thickness. The first intermediate clinical results after six months are presented.[1]

Study design

The study population comprised 75 patients aged between 18 and 50. Each patient received at least two class II restorations. The cavities were prepared employing a minimally invasive approach, not involving bevelling of the enamel margins. In addition, extra attention was paid to the fact that the cervical edges were above the gingival margin. Deep cavities close to the pulp were lined with a layer of calcium hydroxide. Cotton rolls and saliva ejectors were used to keep saliva away from the site. Futurabond U (VOCO) was applied using the self-etch mode in accordance with the manufacturer's specifications. This was followed by the application of Admira Fusion x-tra. Two groups were defined, each containing 85 restorations. In the first group, Admira Fusion x-tra was applied using the incremental technique with a maximum layer thickness of 2 mm. In the second group, the so-called bulk fill technique was employed, i.e., increments with layer thicknesses of up to 4 mm. Following this pattern, deep cavities were treated with one or two increments first and then covered with a final increment of 4 mm. After the finishing and polishing, each restoration was assessed based on the USPHS criteria (initial).[2] A follow-up evaluation was performed six months after placement of the restoration furthermore annually until the end of the clinical study after four years.

Recall overview

Restorative material used	Number of assessed restorations		Maxilla		Mandible		Total
	Initial	6 months	Premolar	Molar	Premolar	Molar	
Admira Fusion x-tra (4 mm, bulk fill technique)	95	95	15	20	15	45	95
Admira Fusion x-tra (2 mm, incremental technique)	95	95	15	20	10	50	95
Total restorations	190	190					190

Results

After six months, it was possible to evaluate all the restorations as none had been lost, the following figure shows the results of the evaluation. After six months, no significant differences were observed between the two different restorative techniques, all restorations were in an excellent clinical condition.

Literature

[1] Abdalla et al., 2015.
[2] Cvar JF, Ryge G, 2005.

Clinical assessment of Admira Fusion x-tra after 6 months.[1]

Literature

[1] Cvar JF, Ryge G, 2005.

9.3. Clinical evaluation of Admira® Fusion and Admira® Fusion x-tra in posterior teeth restorations, 6 months results

Aim

The goal of the 24-month study is to clinically evaluate class II restorations. These restorations were produced with the nanohybrid ORMOCER® restorative materials Admira Fusion and Admira Fusion x-tra. The materials differ only in terms of their type of application. Admira Fusion x-tra can be applied in layer thicknesses of up to 4 mm, whereas Admira Fusion is limited to layer thicknesses of 2 mm. The first intermediate results after six month are presented.

Study design

A total of 30 patients took part in the study. They received at least two class II restorations – one with Admira Fusion and one with Admira Fusion x-tra, the fast-track variant. Very deep cavities were firstly filled with calcium hydroxide cement (Dycal, Dentsply) and then with a thin layer of a conventional glass ionomer cement (Meron, VOCO). Deep cavities were lined with a conventional glass ionomer cement. Futurabond U (VOCO) was used as the adhesive in all cases. It was applied in self-etch mode according to the manufacturer's instructions. Admira Fusion was applied in increments of 2 mm, each light-cured for 20 s. Admira Fusion x-tra was applied using the bulk fill technique in layers no more than 4 mm thick and was light-cured for 20 s. Another layer was applied and light-cured for cavities deeper than 4 mm. The initial evaluation, which was carried out by two professional evaluators, took place after finishing and polishing. The FDI criteria[2][3] were used for the evaluation, taking aesthetic, functional and biological parameters into consideration. The intervals chosen for the evaluations were: initial (after 7 days), after 6 months, after 12 months and after 24 months.

Recall overview

Restorative material used	Number of assessed restorations	
	Initial	6 months
Admira Fusion	30	28
Admira Fusion x-tra	30	28
Total restorations	60	56

Results

The intermediate results, obtained after the first recall, for the class II restorations using Admira Fusion and Admira Fusion x-tra are shown in Figures 1 to 3. All the restorations show excellent clinical results for the evaluated parameters for aesthetics, functionality and biology.

Literatur
[1] Torres et al., 2016.
[2] Hickel et al., 2007.
[3] Hickel et al., 2010.

Figure 1: Aesthetic parameters.[1]

Literature

[1] Torres et al., 2016.

Figure 2: Functional parameters.[1]

Literature

[1] Torres et al., 2016.

Figure 3: Biological parameters.[1]

Literature

[1] Torres et al., 2016.

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