Heraeus

Heraeus Dental Science

Venus® Bulk Fill
Scientific Compendium

Experts in dialogue.

Preface

Venus Bulk Fill is the solution for the main demands of general dental practitioners for posterior restorations: fast and easy placement and durability.

The durability of a restoration depends on several factors. Apart from the operator and the environment in the oral cavity, the material properties are very important for the longevity of a filling.

Bulk filling materials need to fulfill tougher requirements than conventional resin composite materials. These materials need excellent low shrinkage stress values as the bulk layering does not allow a compensation of the cavity's c-factor by layering in increments. A high remaining shrinkage stress can lead to postoperative sensitivities, marginal gaps, staining, caries and tooth fractures.

Compared to conventional composites bulk fill materials need to cure safely in extended layer thickness. Also a high degree of cure is beneficial for higher mechanical resistance.

This scientific compendium contains external study results which demonstrate the excellent properties of Venus Bulk Fill: low shrinkage stress, safe depth of cure up to 4mm, high degree of cure and a marginal quality which is comparable to conventional layered resin composite restorations..

To experience the fast and easy placement of Venus Bulk Fill we like to invite you to try it by yourselves.

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Content

Venus® Bulk Fill
Product description

Venus Bulk Fill is a low stress flowable composite that will enable bulk filling of 4 mm and provide an efficient and easy solution for posterior restorations.

Venus Bulk Fill delivers:
- Self-adaptive handling eliminates steps
- ideal coverage of cavity floor and walls
- Low shrinkage stress for durable restorations
- Highly radiopaque for safe diagnosis

Faster, aesthetic posterior restorations. Simplified.

Venus Bulk Fill is an advanced posterior restorative solution that provides dentists with a faster, easier technique than incremental layering. Ideal for use as a base in class I and II direct restorations (up to 4 mm) or as a cavitiy lining under direct restorative materials in class I and II. The result – a reduction in chair time, and a more efficient and cost effective restoration.

82 % of surveyed dentists claim a savings up to 10 hours of chair time per month when they use a bulk fill material*.

What makes Venus Bulk Fill so efficient?
- Easy placement technique in 4 mm increments – no longer a need to fill with several 2 mm layers
- Self-adapting handling allows for ideal cavity adaptation – eliminating steps prior to final cure
- Compatibility with all methacrylate based bonding adhesives and composites
- Simple dispensing and placement via a convenient Pre-Loaded Tip (PLT) or a non-dripping syringe

* Integrated media survey may 2010 in USA

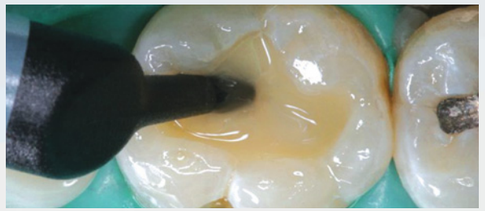
Application of
Venus® Bulk Fill

Venus Bulk Fill Class I
Posterior Restoration

Amalgam restoration and recurrent decay were removed buccolingually yielding a class I preparation.

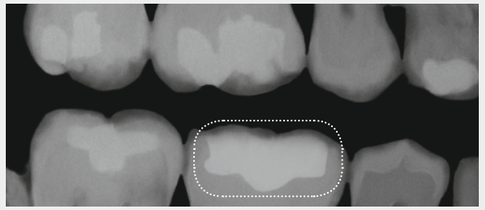
iBOND Self Etch, chosen for its high bond strength, was then applied to the preparation and agitated with a micro-brush for 20 seconds.

Chosen for its low shrinkage stress and superior ease of use, Venus Bulk Fill was used to fill approximately 4 mm of the pulpal floor.



Due to the exceptional flow and self adapting properties of Venus Bulk Fill, instrumental manipulation was not necessary, and material was light cured for 20 seconds.

A final layer of Venus Diamond shade A2 was applied and adapted to the margins of the restoration, then light cured for 20 seconds.



Venus Bulk Fill demonstrates the high radiopacity required for accurate and reliable diagnosis.

Venus® Bulk Fill
Material properties

Venus Bulk Fill
Scientifically tested

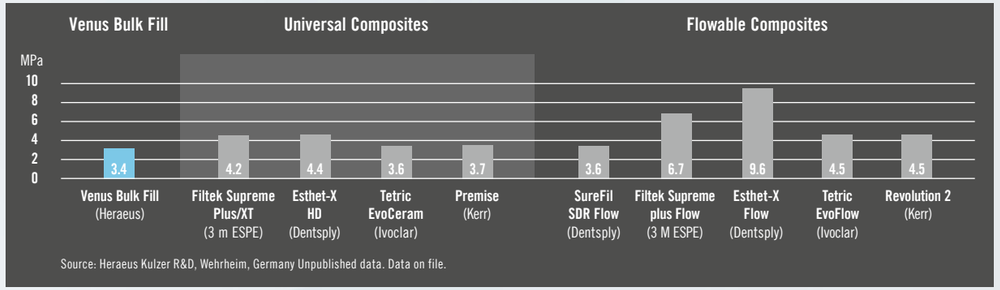
Produces superior, long lasting posterior restorations and delivers the peace of mind of clinical efficacy that dentists expect from restorative materials.

Properties of Venus Bulk Fill	Venus Bulk Fill/ Heraeus Universal Shade
Curing Depth [mm] (ISO 4049)	6.2
Contraction Stress [MPa] (Shrinkage stress after 24 h, photoelastic measurement)	3.4
Compressive Strength [MPa]	331
Flexural Strength [MPa]	120
Radiopacity [%-Al] (ISO 4049)	300
3 Body Wear Resistance [µm] (ACTA method, poppy seed, 300.000 cycl.) [mm^3]	32 0.31
Working Time [s] (ISO 4049)	80
Conversion Rate [%] (Blue light; 600 mW/cm^2; 20 sec, FTIR-Spectrometer)	55

Source: Heraeus Kulzer R&D, Wehrheim, Germany Unpublished data. Data on file.

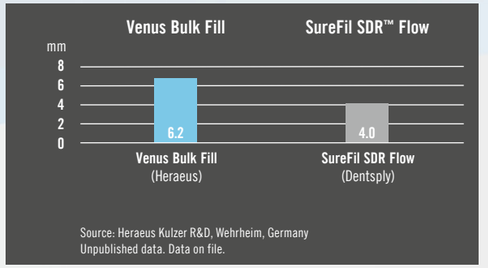
Venus® Bulk Fill
Material properties

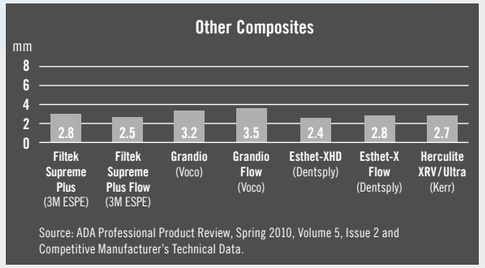
Shrinkage Stress
The result



Venus Bulk Fill exhibits a reduction in shrinkage stress which will reduce internal forces on bonded interfaces.

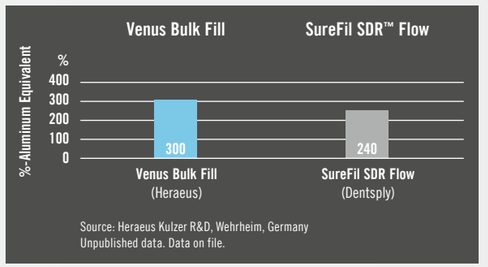
Depth of Cure
The result

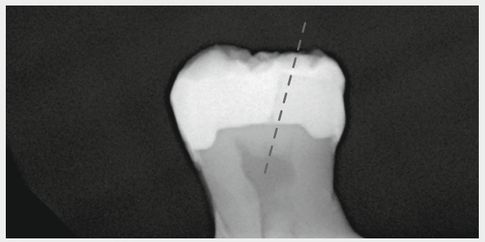




Venus Bulk Fill reveals a high depth of cure for the safe cure of thick layers up to 4 mm.

Radiopacity
The result





Venus Bulk Fill / SureFil SDR™ Flow

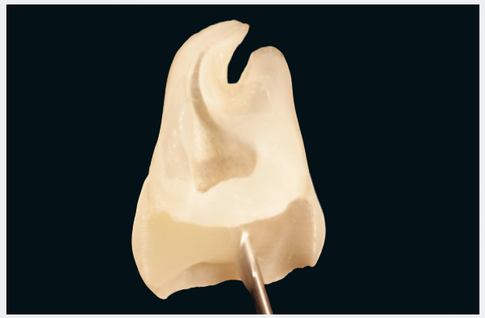
Venus Bulk Fill shows more than 250 % aluminium radiopacity. The higher radiopacity ensures clear diagnostic capabilities and allows for more accurate diagnosis for the dentist and patient.

Venus® Bulk Fill
Clinical application

Venus Bulk Fill Class II
Simulation of Posterior Restoration

In the following the application of Venus Bulk Fill in a mod-cavity in a maxillary tooth is simulated. The molar was cut in mesio-distal direction. The mesial and distal enamel walls were left imitating the usage of matrix band for these photographs.

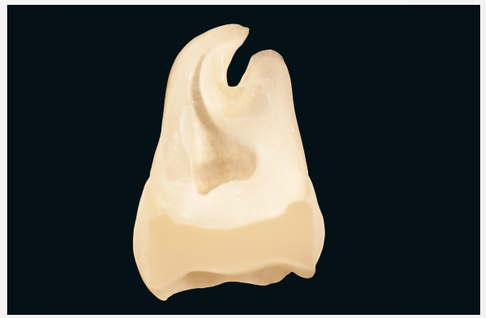
Venus Bulk Fill flows easily and safely into narrow areas of the cavity



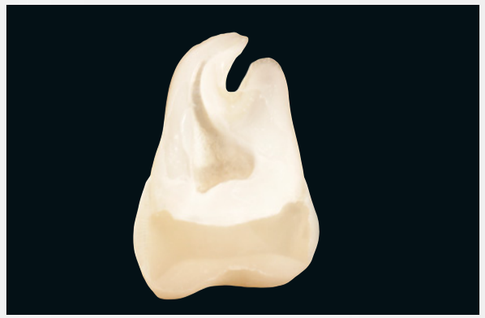
The bulk filling of the cavity can be done very fast

It allows homogenous filling

The low shrinkage stress and excellent curing properties facilitate Venus Bulk Fill to be placed into layers up to 4 mm



Venus Bulk Fill stays in maxillary cavities even after 5 min prior curing. It does not flow off the cavity

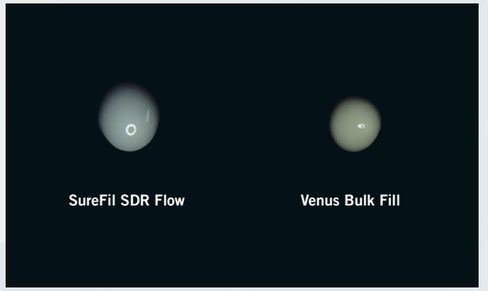


Finished restoration with Venus Bulk Fill and Venus Diamond as occlusal layer

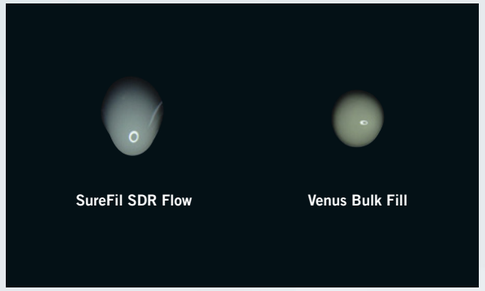
Venus® Bulk Fill
Clinical application

Venus Bulk Fill
Optimal flowability

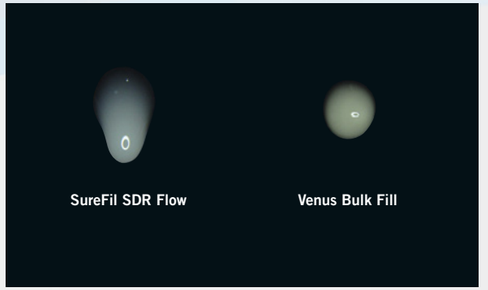
Flowability comparsion of 2 bulk filling materials at different times:
Left drop: SureFil SDR (Dentsply) Right drop: Venus Bulk Fill
Materials were placed on a vertical aligned plastic surface at room temperature.
Source: R&D Heraeus Kulzer. Internal data.



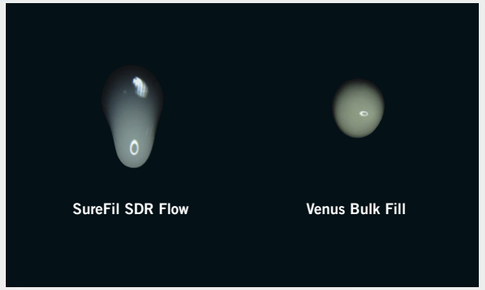
Time 0s



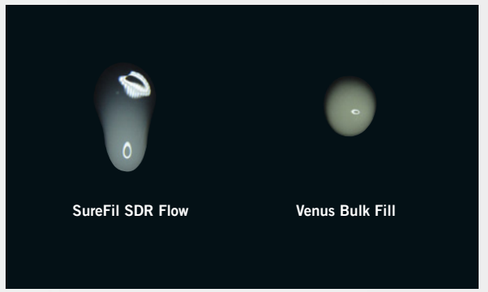
Time 10s



Time 32s



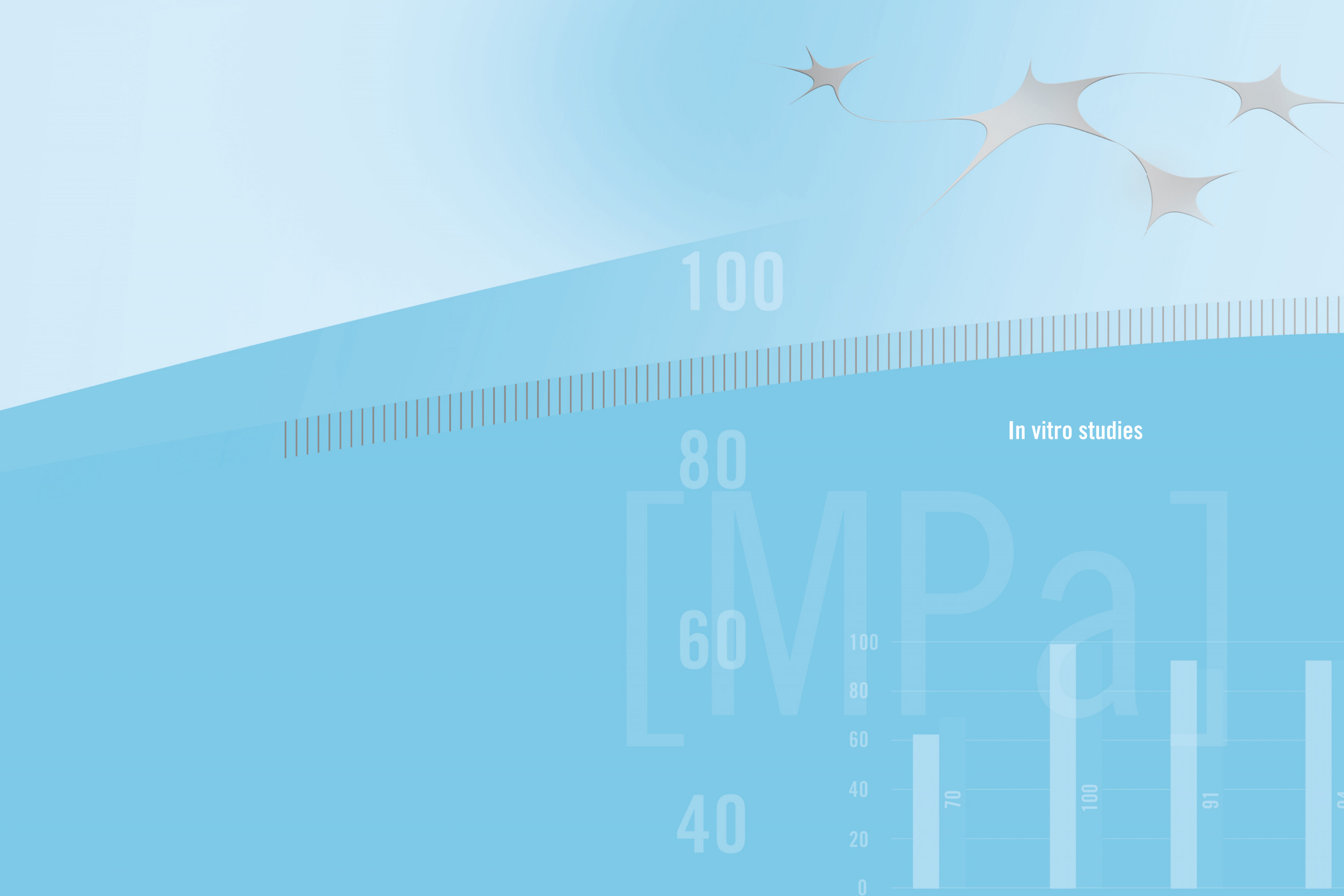
Time 44s



Time 62s

Venus Bulk Fill stays in place.

In vitro studies



Venus® Bulk Fill – In vitro studies
Evaluation of the shrinkage stress of a flowable composite for 24 hours

Evaluation of the contraction stress of a flowable composite for 24 hours

Source
Prof. L. Breschi, Prof. M. Cadenaro, University of Trieste, Italy. Unpublished test report, 2010. Data on file

Objective
Aim of the study was to evaluate the shrinkage stress of two bulk fill materials by two stress measurement techniques.

Materials and Methods
Contraction stress development of Venus Bulk Fill (Heraeus Kulzer) and SureFil SDR Flow (Dentsply) was measured using a high compliance stress-strain analyser and a low compliance system.

For the test with the high compliance system composite (n=20/material) was bulk filled into a cavity (height: 2 mm, diameter 2 mm) between 2 metal attachments. One of the attachments was connected with a load cell the other attachment was connected to the aluminium frame of the device. The composite was cured for 40 s and the contraction force was recorded continuously for 24 h.

The low-compliance system was consisted of two stainless steel cylinders as bonding substrates. The cylinders were attached to a universal testing machine. Composite was filled between both cylinders (n=20/material). The cylinders were kept at a constant distance of 2 mm by an extensometer during the experiment. The composite was light cured for 40 s and the force to keep the height of the composite sample constant was recorded for 24 h.

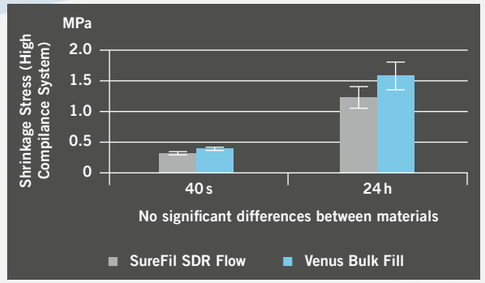
Shrinkage stress (MPa) was calculated as the force value (N) per area unit (force value/bonded surface size) at 40 s, 300 s and 24 h.

Statistics were done by a by two-way ANOVA. Differences between groups were identified using Tukey's multiple comparison test at $\alpha=0.05$.

Results
Means of Shrinkage stress

	40 s High Compliance [MPa]	40 s Low Compliance [MPa]	300 s High Compliance [MPa]	300 s Low Compliance [MPa]	24 h High Compliance [MPa]
Venus Bulk Fill	0.4 ± 0.04^{a}	0.61 ± 0.07^{b}	0.64 ± 0.03^{b}	0.80 ± 0.17^{b}	1.59 ± 0.19^{c}
SureFil SDR Flow	0.33 ± 0.04^{a}	$0.46 \pm 0.05^{a,b}$	0.46 ± 0.03^{a}	$0.56 \pm 0.09^{a,b}$	1.24 ± 0.18^{c}

Same letters indicate no significant differences.



Similar low shrinkage stress of Bulk Fill materials.

No significant difference in shrinkage stress was detected between the Venus Bulk Fill and SureFil SDR after 40 s and 24 hours.

Conclusion
Venus Bulk Fill displays comparable low shrinkage stress values than SureFil SDR Flow in those tests. Low shrinkage stress is mandatory for bulk filling materials to prevent the restoration from delamination and the development of hairline cracks or fractures of the remaining tooth structure.

Venus® Bulk Fill – In vitro studies
Shrinkage stress

Venus Bulk Fill research results

Source
Dr. M. Miller, Reality Research Lab, USA. Unpublished test report 2011. Data on file

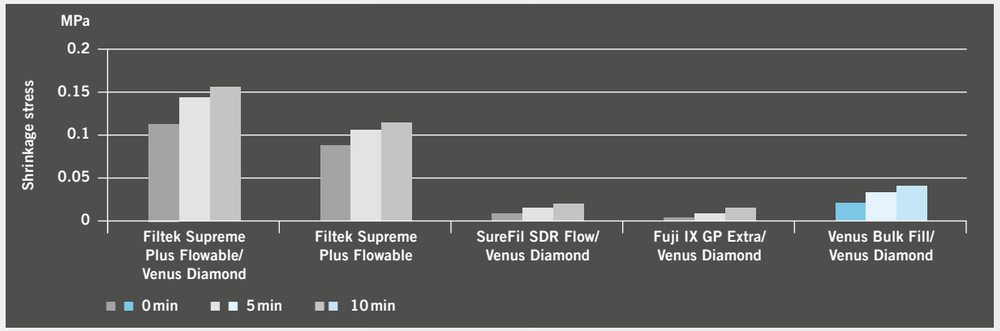
Objective
Aim of this study was to investigate the shrinkage stress via a strain measurement of 2 bulk fill flowable materials in combination with a conventional composite as top layer compared to a glass ionomer cement (GIC) and a conventional flowable.

Materials and Methods
Sixty extracted intact molars were randomly divided into 6 groups. Lead wires with attached strain gauges (Vishay Micro Measurements) were bonded (with a vertical orientation) to the buccal surface just above the cemento-enamel junction. Two teeth with attached strain gauges were mounted close to each other in a nylon mounting ring with dental stone. The teeth were mounted with 2 mm of root surface left exposed. The gauges were then connected to the strain measurement system (Model P-3 Strain Indicator and Recorder, Vishay Micro Measurements), with the strain reading directly proportional to the deformation of the tooth structure. The teeth were prepared with MOD preparations (5 mm in depth in proximal boxes and 4 mm in depth for the pulpal wall).

The six groups were: 1: SureFil SDR Flow (Dentsply)/Venus Diamond (Heraeus Kulzer), 2: Venus Bulk Fill (Heraeus Kulzer)/ Venus Diamond, 3: Filtek Supreme Plus Flowable (3M ESPE)/ Venus Diamond, 4: Fuji IX GP Extra (GC)/Venus Diamond, 5: Filtek Supreme Plus Flowable, 6: Fuji IX GP Extra

The preparations in groups 1, 2, 3, and 5 were etched and iBond Total Etch (Heraeus Kulzer) was applied and light cured for 20 s. In groups 4 and 6, Cavity Conditioner (GC) was applied to the cavity for 10 seconds. Fuji IX was mixed, injected, and allowed to set. During the setting time, Fuji IX was coated with iBond Total Etch. In group 4, after Fuji IX had set rock hard, the cavities were etched and the adhesive was applied as previously described. The teeth in groups 1–4 were filled to within 1 mm of the occlusal surface with the respective base materials and light-cured for 40 s (groups 1, 2, and 3). The occlusal increment in groups 1–4 was restored with Venus Diamond. In groups 5 & 6, the base materials were used to restore the entire cavity. Data were obtained immediately after each specimen was restored and then after 5 and 10 minutes.

Results



Shrinkage stress of Venus Bulk Fill is equal low to SDR and GIC.

The data clearly show statistically significant differences at the $p<.001$ level and three separate groups. This was the same for all three time points. In each case, Filtek Supreme Plus Flowable alone and in combination with Venus Diamond were separate groups and produced significantly higher levels of shrinkage stress. The four other groups showed no statistically significant differences.

Conclusion
Venus Bulk Fill produces shrinkage stress equal to SureFil SDR Flow and Fuji IX GP Extra, which is significantly less than that produced by the conventional flowable, Filtek Supreme Plus Flowable.

Venus® Bulk Fill – In vitro studies

Comparsion of marginal quality of different adhesives, resin composites and filling techniques combinations

Comparsion of marginal quality of different adhesives, resin composites and filling techniques combinations

Source

Prof. Dr. R. Frankenberger, University of Marburg, Germany. Unpublished test report, 2011. Data on file

Objective

Purpose of this study was to investigate the marginal integrity of two different resin composites using two different filling techniques subject to two different adhesives after thermo-mechanical loading.

Materials and Methods

Standardised class II cavity preparations with the distal proximal margin located 1–2 mm below the cement-enamel junction were performed in 32 intact human third molars.

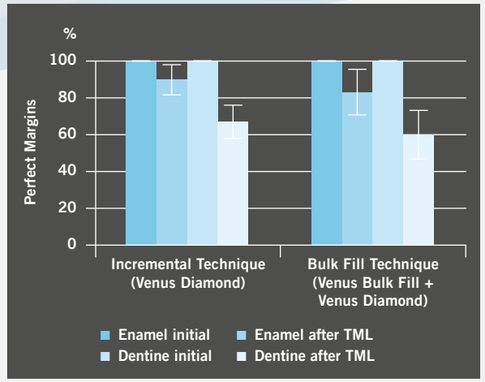
Prepared cavities were treated with iBond Total Etch or iBond Self Etch (Heraeus Kulzer). 16 teeth were randomly selected for each adhesive. The adhesives and resin composites (Venus Diamond and Venus Bulk-Fill, Heraeus Kulzer) were polymerised with a Translux CL light-curing unit (Heraeus Kulzer). The adhesive was polymerised for 40 s. One half of the cavities were restored with Venus Bulk Fill in a first 4 mm layer covered with Venus Diamond applied in 2 mm layers for the residual height of the cavity. The other half of the cavities was restored with Venus Diamond in a conventional horizontal layering technique. The increments were separately light-cured for 40 s. Additional light curing was done from the buccal and lingual aspects for an additional 20 s on each side. Proximal margins were finished with flexible disks. Impressions were taken and a first set of replicas was made for SEM evaluation.

Thermo-mechanical loading (TML) of specimens was then performed. The specimens underwent 2.500 thermocycles 5°C and 55°C before being transferred in an artificial oral environment for 100,000 cycles at 50 N. Impressions were taken again and another set of replica was made for each restoration for SEM evaluation.

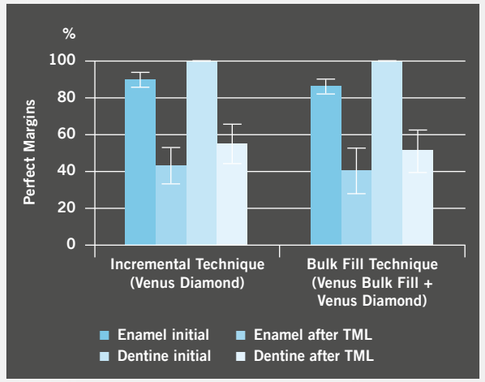
The marginal integrity between resin composite and dentine was expressed as a percentage of the entire margin length in enamel and dentine. Marginal qualities were classified according to the criteria “gap-free margin”, “gap/irregularity” and “not judgeable/artefact”. Afterwards the percentage “gap-free margin” in relation to the individual judgeable margin was calculated as marginal integrity.

Non-parametric tests were used (Kruskal-Wallis test, Wilcoxon matched-pairs signed-ranks test, Mann-Whitney-U test) for pairwise comparisons at the 95% significance level.

Results



Clinical comparable margins (bulk and incremental) with iBOND Total Etch.



Comparable margins (bulk and incremental) with iBOND Self Etch.

Venus® Bulk Fill – In vitro studies

Comparsion of marginal quality of different adhesives, resin composites and filling techniques combinations

Results

Adhesive	Resin composite	Enamel initial	Enamel (TML)	Dentine initial	Dentine (TML)
iBOND Total Etch	Venus Bulk Fill + Venus Diamond	100 A	81.4 (11.9) B	100 A	59.7 (10.7) AB
	Venus Diamond	100 A	90.9 (6.0) A	100 A	63.9 (8.6) A
iBOND Self Etch	Venus Bulk Fill + Venus Diamond	87.3 (4.5) B	40.3 (17.5) C	100 A	50.77 (11.5) B
	Venus Diamond	89.9 (3.9) B	42.1 (9.7) C	100 A	55.1 (10.8) B

Before and after TML: $p<0.05$ in all groups.

Same superscript letters within columns: $p>0.05$.

Conclusion

Marginal integrity of Venus Bulk Fill differs not significantly (within the adhesive group) from the conventional layering with Venus Diamond. The only exception hereof is the marginal integrity on enamel after TML in the iBOND Total Etch group (slight difference of results).

Thermo-mechanical loading leads to a decrease of marginal integrity of the tested composites/ adhesives.

The etch & rinse adhesive iBOND Total Etch has a superior marginal integrity on enamel to the one bottle self-etch adhesive system.

Venus® Bulk Fill – In vitro studies
A comparison of depth of cure between 2 flowable composites

A comparison of depth of cure between 2 flowable composites

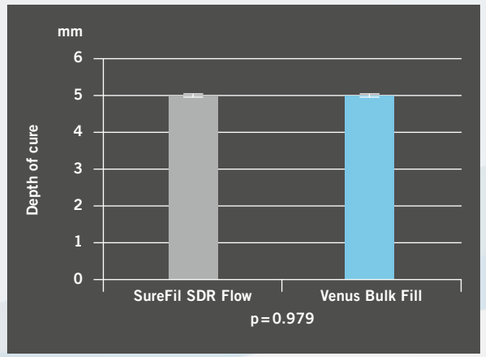
Source
Dr. P. Yaman, University of Michigan, USA. Unpublished test report, 2010. Data on file

Objective
Purpose of this investigation was the determination of the depth of cure of two bulk fill materials.

Materials and Methods
The evaluated materials were Venus Bulk Fill (Heraeus Kulzer) and SureFil SDR Flow (Dentsply).

Each composite was filled according ISO guideline 4049 into a 10x10 mm brass mold. A mylar strip was placed on top of the uncured sample and covered by a 1 mm glass slide. Samples (n=10/composite) were then light cured from the top side for 20 s. Specimens were then removed from the mold and the uncured the material was removed with a plastic spatula. The remaining thickness of each specimen was measured 3 times with a micrometer. The three measurements were averaged to obtain a thickness measurement for each sample. Depth of cure was calculated as half of the obtained mean thickness value.

Results



Safe depth of cure of Venus Bulk Fill.

There was no significant difference between the materials.

Conclusion
Venus Diamond and SureFil SDR Flow present a minimum depth of cure of 5 mm. Therefore, both materials can safely used in layers of 4 mm.

Venus® Bulk Fill – In vitro studies
Effect of curing mode on composite depth of cure

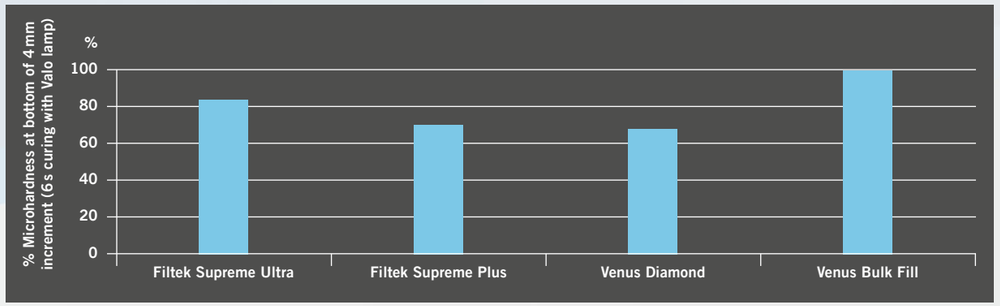
Effect of curing mode on composite depths of cure

Source
Dr. M. Borges, Dr. K. Dias, Dr. R. Pober and Dr. D. Nathanson, University of Rio de Janeiro, Brazil and Boston University, USA. J Dent Res 90 (Spec Iss A), 157, 2011

Objective
Aim of this investigation was to evaluate depths of cure of Filtek Supreme Ultra, Filtek Supreme Plus (both 3M ESPE), Venus Diamond and Venus Bulk Fill (both Heraeus) using 3 curing units/techniques: a) Bluephase (Ivoclar) for 20 s (Blu20); b) Valo (Ultradent) Plasma mode for 3 s (VP3); and c) Valo (Ultradent) Plasma mode for 6 s (VP6).

Materials and Methods
After curing, each specimen (Ø 4 mm, 4 mm height) was longitudinally sectioned and polished for microhardness testing (Knoop, 50 gf, 20 s) as an indication of curing. Indentations were made from 0.1 mm ("Top") of the irradiated surface to the bottom, at 0.5 mm increments (n=5/level). Data were analyzed by ANOVA and SNK test.

Results



100% curing of 4 mm increments with Venus Bulk Fill.

	Filtek Supreme Ultra	Filtek Supreme Plus	Venus Diamond	Venus Bulk Fill
Bluephase 20 s	83%	87%	66%	76%
Valo Plasma Mode 3 s	67%	56%	38%	44%
Valo Plasma Mode 6 s	82%	70%	68%	100%

Filtek Supreme Ultra showed a microhardness of the top surface between 65 and 68.5 KHN. Values for Filtek Supreme Plus ranged between 21.1 and 29.7 KHN. Venus Diamond exhibited hardness values between 45.9 and 49.8. The values for Venus Bulk Fill were between 8 and 16.5 KHN.

The effect of factors studied (material, depth, curing technique) and the interaction between them were significant ($p<0.05$). There was no significant difference between Blu20 and VP6 in curing top surfaces of all composites. The relative curing at 4 mm was depending on material and technique.

Conclusion
Composites designed for bulk filling are capable of 80–100% curing at 4 mm bulk. The curing level is affected both by light intensity and duration. Venus Bulk Fill demonstrates safe curing up to 4 mm layers when a sufficient curing time is used.

Venus® Bulk Fill – In vitro studies

Degree of cure of a new flowable resin-based composite

Degree of cure and flexural tests of a new flowable resin-based composite

Source

PD Dr. N. Ilie, University of Munich, Germany. Unpublished test report, 2010. Data on file

Objective

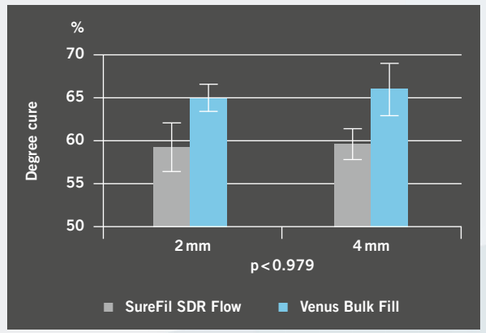
Purpose of this study was to investigate the degree of cure of two flowable composites.

Materials and Methods

Venus Bulk Fill (Heraeus Kulzer) and SureFil SDR Flow (Dentsply) were filled into molds with different heights using bulk fill or incremental technique: 100 µm, 2 mm bulk fill, 4 mm bulk fill, 6 mm bulk fill, 6 mm in 2 mm increments. Specimens of each composite were light cured for 10 s, 20 s and 40 s with a LED curing device (n = 6/composite, curing time, geometry).

Additionally, flexural strength and elastic modulus was measured according ISO 4049. Weibull modulus for both materials was calculated.

Results



Venus Bulk Fill shows approx. 10 % higher degree of cure.

	SureFil SDR Flow	Venus Bulk Fill
Weibull modulus	26.7	21.6
Flexural Modulus [GPa]	4.99 ± 0.36	3.59 ± 0.35
Flexural Strength [GPa]	131.77 ± 5.83	122.7 ± 6.90

Increasing the polymerisation time had only slight effect on the measured properties. There were no significant differences between a polymerisation time of 20 and 40 s. Venus Bulk Fill reveals degree of cure values between 62.4 % (10s, 6mm bulk) and 67.9 % (40s, 4 mm bulk). SDR's degree of cure values ranked between 57.9 % (10 s, 6 mm bulk) and 61.9 % (40 s, 6 mm incremental).

Conclusion

Both materials perform very well regarding degree of cure also in thicker layers. A polymerisation time of 20 s can be recommended for both materials. Venus Bulk Fill exhibits significantly a higher degree of cure than SureFil SDR Flow. A high degree of cure represents a good crosslinking behavior of a material which leads to higher material strength.

Further, Venus Bulk Fill and SureFil SDR Flow demonstrated an unexpected high reliability (Weibull modulus).

Studies were summarised (objectives, materials & methods, results and conclusions) and explained by Heraeus Kulzer based on the data contained in the publications/reports. Also graphs were made by Heraeus Kulzer.

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