VarseoSmile® TriniQ®

COMPENDIUM

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Partners in Progress

BEGO

Summary

Breaking load after 10-year chewing simulation

Breaking load trials before and after a 10-year chewing simulation were performed on three-unit bridges made of VarseoSmile® TriniQ®. Initially, mean breaking loads of 1250 N were observed. The specimens subjected to the 10-year chewing simulation showed mean breaking loads of 1024.1 N. Both results were thus considerably higher than the human biting forces of 720 N that are described in the literature[1].

Objective

One of the significant characteristics of VarseoSmile® TriniQ® is its improved stability compared to other materials that are suitable for 3D printing of permanent restorations. To investigate the long-term stability of bridge restorations made of VarseoSmile® TriniQ® and to confirm the superiority of this material, two test groups, each comprising 16 three-unit bridges, were subjected to a breaking load test. One test group was tested as a baseline and the other test group underwent a 10-year chewing simulation before the breaking load test.
For this test the minimum sample size for the test groups was determined to be 13 specimens. However, the chewing simulator is suitable for a test group size of 16 specimens. Failure of one specimen from this larger test group was defined as acceptable. Furthermore, the test groups should have a mean breaking load that is greater than the clinically expected biting forces both initially and after the 10-year chewing simulation.

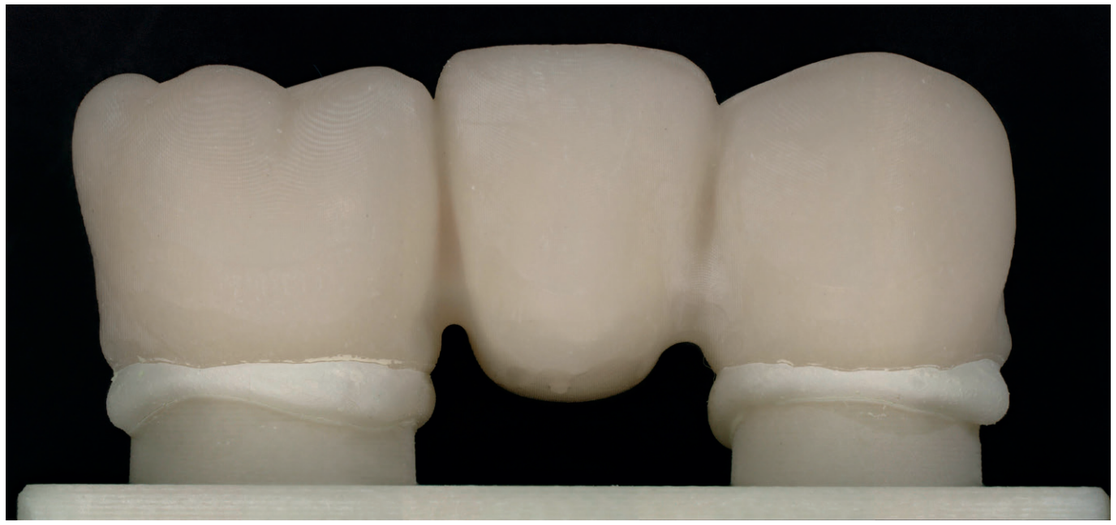

Figure 1: VarseoSmile® TriniQ® specimens for the chewing simulation and subsequent breaking load test

Materials and methods

For the breaking load test, 32 three-unit bridges were prepared from VarseoSmile® TriniQ®. As described in the instructions for use: the occlusal surface was oriented at an angle of 45° to the build platform of the 3D printer, with a minimal wall thickness of the restorations of 1 mm and connector cross-sectional areas of 16 mm². A Max UV (Asiga*) 3D printer was used for the 3D printing. The specimens were cleaned in an ultrasonic bath filled with ethanol. An Otoflash unit (NK Optik*) was used for post-curing.
After removing the support structures, the 3D-printed bridges were adhesively bonded to artificial tooth stumps made from Trinia®. The artificial tooth stumps were first blasted at 1.5 bar with 110 µm aluminum oxide. The adhesive surfaces of the bridges were conditioned with Monobond Plus primer (Ivoclar*) and dried with compressed air. The bridges were then cemented onto the artificial tooth stumps using the adhesive Variolink Esthetic DC (Ivoclar). Because the overhang had no relevance for the test, it was not considered further. To polymerize the adhesive cementation, the specimens were irradiated for about 10 seconds with UV light from each side.

A 10-year chewing simulation was performed on 16 of the total of 32 specimens that had been prepared identically. The test comprised applying a load to the bridge unit of the specimen of 50 N over 2.4 million cycles and 10,181 thermocycles between 5 °C and 55 °C.

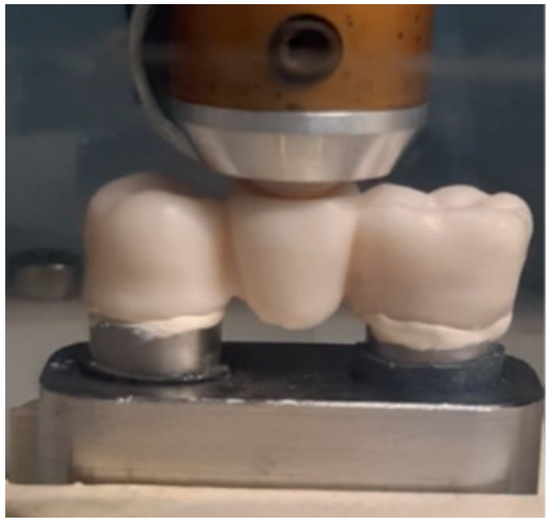

Figure 2: Test setup in the chewing simulator

All specimens then underwent a breaking load test, and the force applied until breakage was measured.

Results

The 16 specimens in the baseline group showed a mean breaking load of 1250.0 N with a standard deviation of 90.1 N.
From the artificially aged group, one specimen showed several cracks after the 10-year chewing simulation. This specimen also underwent the breaking load test and, despite the visible damage, still achieved a breaking load of 342 N. Nevertheless, it was not included in the determination of the overall result for the artificially aged test group.
The 15 remaining specimens after the 10-year chewing simulation showed a mean breaking load of 1024.1 N with a standard deviation of 90.8 N. Of note was that all remaining specimens showed breaking loads that were considerably higher than the maximum reported human biting forces of 720 N.

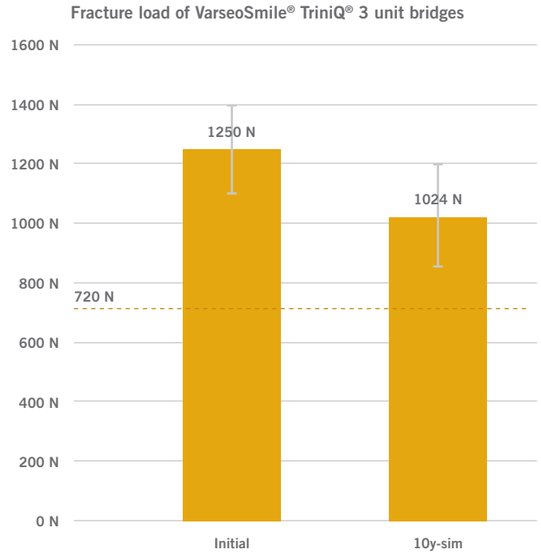

Figure 3: Mean breaking loads for the baseline and the artificially aged test group of three-unit bridges made of VarseoSmile® TriniQ®

Conclusion

The results of this in-vitro study impressively confirm the fundamental suitability of VarseoSmile® TriniQ® for fabricating permanent three-unit bridge restorations. Although one of the artificially aged bridges developed cracks after the 10-year chewing simulation and subsequently a lower breaking load as a result, it must nevertheless be stressed that the breaking load was still 342 N and no splintering occurred during the chewing simulation.
In total, the acceptance criteria for the test were clearly satisfied and even after the 10-year chewing simulation breaking loads were achieved that were clearly greater than the human biting forces reported in the literature[1].

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[1] Shinogaya, T., et al., Effects of ethnicity, gender and age on clenching force and load distribution. Clin Oral Investig, 2001. 5(1):63–8

µCT analysis of the cementation after 10-year chewing simulation

In this study the effect of cyclic loading on the cementation of three-unit bridges made of VarseoSmile® TriniQ® was investigated in a µCT scanner. The cementation of the specimens after a 10-year chewing simulation showed barely visible changes. A mean degradation of the cementation of 2 % was measured. The cyclic loading in a 10-year chewing simulation had no relevant effect on the cementation of the three-unit bridges made of VarseoSmile® TriniQ®.

Objective
This study investigated the effect of cyclic loading of the bridge pontic in three-unit bridges made of VarseoSmile® TriniQ® on the cementation of the bridge crowns. The aim was to confirm that restorations did not show any decementation even after extensive dynamic loading. The condition of the cementation was examined before and after a 10-year chewing simulation performed on 16 specimens prepared from VarseoSmile® TriniQ®.

Method
The 16 specimens were fabricated using the same method described in the investigation “Breaking load after 10-year chewing simulation.” The specimens were first analyzed with a µCT scanner. Images of the cementation were prepared and the cementation volume was determined in each case. After a 10-year chewing simulation with 2.4 million simulated chewing cycles with a force application in each case of 50 N on the bridge unit and 10,181 thermocycles between 5 °C and 55 °C, the µCT analysis was repeated. Along with the visual analysis of the cementation, the initial cement volume and the cement volume after the chewing simulation were considered.

Results
All 16 µCT images at baseline showed small areas in which there was no cement. As a result of the 10-year chewing simulation, the cementation showed slight degradation in the occlusal direction (see Fig. 4). The examination of the cement volume at baseline and after the 10-year chewing simulation showed degradation of 2.6 % on average.

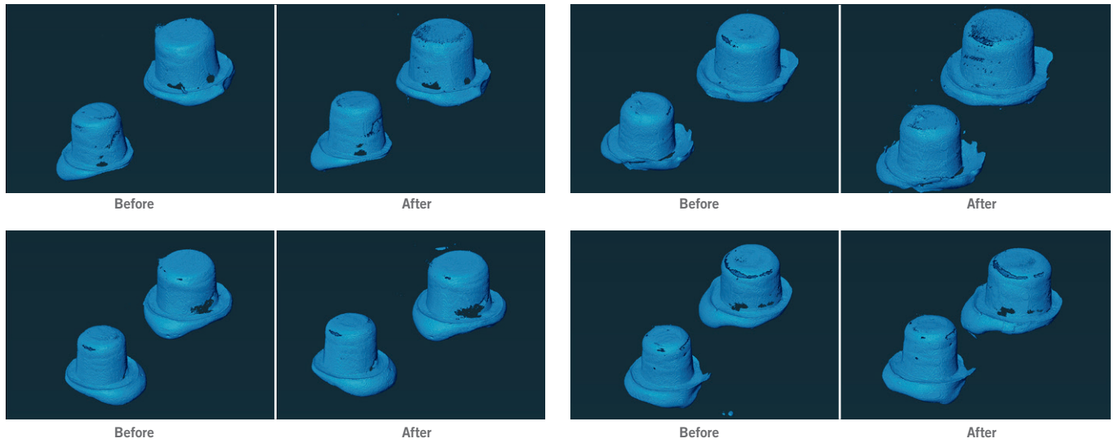

Figure 4: Examples from the µCT analysis (4 of 16) before and after 10-year chewing simulation

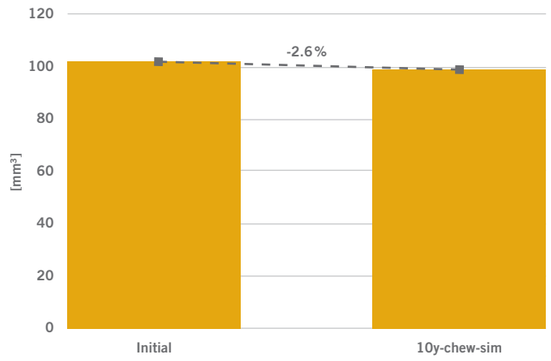

Figure 5: Mean baseline cement volume and mean cement volume after 10-year chewing simulation

Conclusion
The changes observed in the cementation in the visual inspection after the 10-year chewing simulation are unremarkable and not relevant for the restoration bond. Despite the dynamic loading of the samples, no decementation has occurred. The numerically determined degradation in volume of the cementation of 2.6 % is comparably low and can also primarily be explained by lateral fracturing during the chewing simulation of the cement mass emerging from beneath the restoration (see Fig. 6).
It is also remarkable that the manual process of cementation has no influence on the stability of the cementation. This can be identified by the areas without cement (see Fig. 4). These areas were already present at baseline and only change minimally as a result of the 10-year chewing simulation.

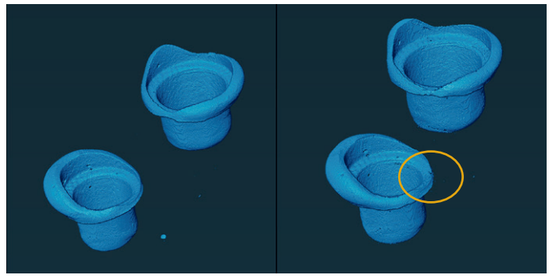

Figure 6: Visible fracture of the cement material after the 10-year chewing simulation

Investigation of the radiopacity

This study aimed to show that restorations made of VarseoSmile® TriniQ® are visible on X-ray images. Specimens made of VarseoSmile® TriniQ® were tested for radiopacity using DIN EN ISO 13116. The results indicate that VarseoSmile® TriniQ® is visible on X-ray images.

Objective
The ability to detect existing restorations on X-ray images or images prepared using similar technology is clinically relevant, for example, during X-ray diagnostics. However, complete radiopacity is often not desired because secondary caries beneath a crown, for example, could then not be detected. Furthermore, the visibility of dental restoration materials in some international sales regions is relevant for their consideration by associated health insurance funds. This study therefore aimed to show that restorations made of VarseoSmile® TriniQ® are visible on X-ray images.

Method
Objects made of VarseoSmile® TriniQ® were tested for radiopacity according to DIN EN ISO 13116, which describes a test method to determine the radiopacity of dental materials. Accordingly, 10 round specimens of VarseoSmile® TriniQ® with a thickness of 1 mm and a diameter of 15 mm were prepared as described in the instructions for use. The specimens were printed with a Max UV (Asiga*) 3D printer, then cleaned with ethanol in a commercial ultrasonic bath followed by post-curing with an Otoflash unit (NK Optik*).
X-ray images were then prepared of the specimens next to an aluminum step wedge. To analyze the test, the gray value of the specimen in the X-ray image is compared to the corresponding gray value of the aluminum step wedge. The corresponding thickness of the aluminum step wedge at the measured point gives the equivalent value of the 1 mm thick specimen relative to the 1 mm thick aluminum. According to DIN EN ISO 13116, materials are considered to be radiopaque from an equivalent value of 1 mm.

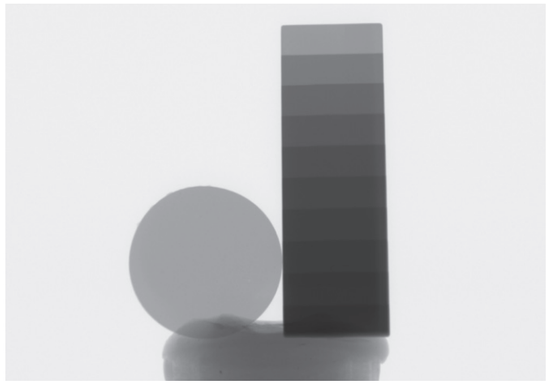

Figure 7: VarseoSmile® TriniQ® specimen next to an aluminum step wedge

Results
The specimens made of VarseoSmile® TriniQ® showed gray values in the subsequent examination of the X-ray images that corresponded on average to a thickness on the aluminum step wedge of 0.445 mm. VarseoSmile® TriniQ® is not radiopaque according to the requirements of DIN EN ISO 13116. However, objects made of VarseoSmile® TriniQ® are readily visible on X-ray images as can be seen in Figure 7.

Conclusion
VarseoSmile® TriniQ® is not radiopaque according to DIN EN ISO 13116. However, from a clinical perspective this would also not be optimal in many cases because pathological changes beneath radiopaque restorations cannot be detected. Rather, materials that can be detected on X-ray images but that appear transparent are desirable so that the situation beneath the restoration can also be evaluated. VarseoSmile® TriniQ® satisfies these conditions.

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Wear behavior

The wear behavior of VarseoSmile® TriniQ® was compared to zirconia and lithium disilicate in a pin-on-block test. Although VarseoSmile® TriniQ® showed greater wear depths in this comparison, the results were similar to the wear depths of lithium disilicate. Furthermore, VarseoSmile® TriniQ® caused the least antagonist wear.

Objective
The objective of this study was to compare the wear behavior of different restoration materials in vitro in a linear wear test using impact impulses. The materials underwent testing using a pin-on-block (POB) method with a steatite ball as the antagonist.

Method
This study examined eight specimens in the shape of small round plates with a diameter of 10 mm and a thickness of 2 mm made of the following restoration materials:

Investigated restoration materials

Specimen	Product name	Manufacturer
Ceramic-filled 3D material	VarseoSmile® TriniQ®	BEGO
Lithium disilicate	IPS e.max*	Ivoclar*
Zirconia	YZ ST*	VITA*

Table 1: Investigated restoration materials

The specimens were loaded in the Regensburg POB chewing simulator with the following test parameters:
- 120,000 cycles with 50 N loading force at a frequency of 1.2 Hz
- Lateral movement 1 mm and displacement path of the antagonist 1 mm
- Performed in a water bath at room temperature

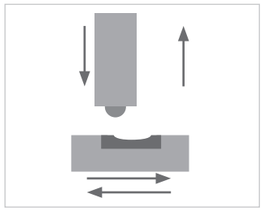

Figure 8: Schematic diagram of the POB chewing simulator

The specimens were loaded with a steatite ball (CeramTec*, D, d = 3 mm) as antagonist to simulate the wear behavior of the respective test-material compared to ceramic.
Following the POB chewing simulation, the wear surfaces of the specimens and the antagonists were surveyed using 3D laser microscopy (KJ color 3D laser scanning microscope, KEYENCE*), and the mean wear depths were determined.

Results
For the three restoration materials investigated, the following wear depths were determined:

Mean wear depths after POB chewing simulation

Specimen	Mean wear depth [µm]	SD of the mean wear depth [µm]
VarseoSmile® TriniQ®	-169.2	37.3
Lithium disilicate	-136.2	40.5
Zirconia	-7.9	2.0

Table 2: Mean wear depths after POB chewing simulation (numerical)

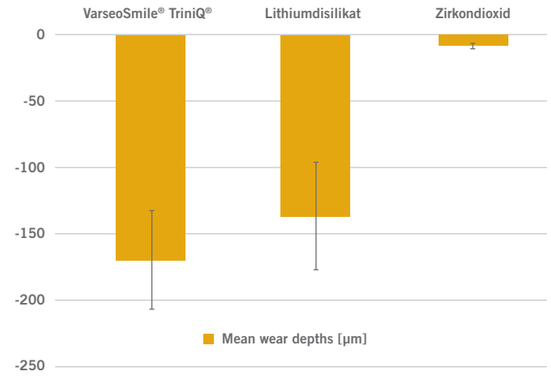

Table 3: Mean wear depths after POB chewing simulation (graphical)

In the evaluation of the wear facets, no spalling or eruptions were identified. All materials showed a typical teardrop-shaped or round wear facet with grinding areas in the facet.

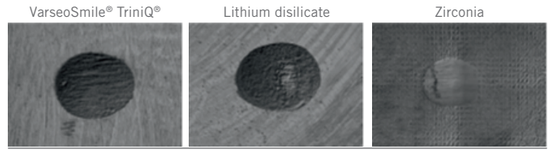

Figure 9: Wear facets after POB chewing simulation

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The mean wear of the steatite ball used as the antagonist for each restoration material was determined as follows:

Mittlerer Verschleiß des Antagonisten nach POB Kausimulation

Specimen	Mean wear of antagonist [%]	SD of the mean wear of antagonist [%]
VarseoSmile® TriniQ®	12.3	4.6
Lithium disilicate	17.3	3.7
Zirconia	22.3	6.1

Table 4: Mean wear of the antagonist after POB chewing simulation (numerical)

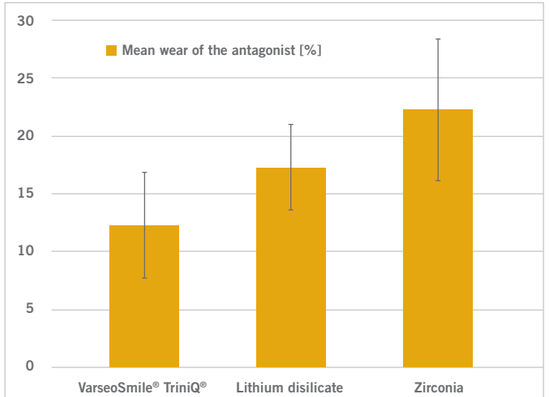

Table 5: Mean wear of the antagonist after POB chewing simulation (graphical)

Conclusion
Differences in the wear depths were identified for the restoration materials investigated. While zirconia showed hardly any wear as a result of the POB chewing simulation, VarseoSmile® TriniQ® and lithium disilicate had a similar range of values, with VarseoSmile® TriniQ® showing the greatest wear with a value of 169.2 µm compared to 136.2 µm (lithium disilicate) and 7.9 µm (zirconia) in this material comparison.
In comparison, the wear on the antagonists was, as expected, in the reverse order, namely from VarseoSmile® TriniQ® with the lowest antagonist wear to lithium disilicate to zirconia with the highest wear of the antagonist in this comparison. What is noteworthy is that the ratio of the specimen wear to antagonist wear was worse for lithium disilicate than for VarseoSmile® TriniQ®.

Bond strength with adhesive cements and composites

Whether 3D-printed restorations can be repaired or supplemented and which cements can be used to insert them are frequently asked questions. A shear bond test as described in DIN EN ISO 10477 was used to answer these questions for VarseoSmile® TriniQ®. The shear bond strength with the composites Tetric EvoCeram (Ivoclar*) and VM LC (VITA*) as well as the adhesive cements Variolink Esthetic DC (Ivoclar*), RelyX Universal (3M*), and Panavia v5 (Kuraray Noritake*) was investigated. VarseoSmile® TriniQ® showed a very good bond strength with all materials included in the test that was clearly greater than the standard requirement.

Objective
The aim of this study was to investigate the adhesive bond between 3D printed objects made of VarseoSmile® TriniQ® and different dental composites commonly used for repair and augmentation as well as several adhesive cements established on the market. The quality of the adhesive bond was evaluated based on the bond strength determined using the testing standard for polymer-based crown and veneer materials DIN EN ISO 10477. According to the standard, adequate bond strength of the material with VarseoSmile® TriniQ® is given when at least four of five specimens have a bond strength of ≥5 MPa.

Method
The following products were selected as representative materials for testing the bond strength with dental composites and adhesive cements:

Materials used in the shear bond study

Material	Product name	Manufacturer	Abbreviation
Direct composite	Tetric EvoCeram	Ivoclar*	TEC
Indirect composite	VM LC	VITA*	VML
Luting composite	Variolink Esthetic DC	Ivoclar*	EDC
Luting composite	RelyX Universal	3M*	RXU
Luting composite	Panavia v5	Kuraray Noritake*	PNV

Table 6: Materials used in the shear bond study

To fabricate the specimens for the shear bond test, 25 substrates of VarseoSmile® TriniQ® were prepared with the format 10 × 10 mm and a thickness of 2.1 mm. A cylinder with a diameter of 5 mm of each of the above materials was applied to five substrates. The substrates were conditioned beforehand as specified by the manufacturer (current instructions for use):

TEC	Surface roughened with a diamond bur	Surface cleaned with oil-free and water-free compressed air	Monobond Plus primer applied; 60 s reaction time observed	Cylinder of TEC with 5 mm diameter applied	Polymerized using 10 s exposure to UV light from all sides
VML	Surface blasted with aluminum oxide (50 µm) at 2.0 bar	Surface cleaned with oil-free and water-free compressed air	VITA VM LC MODELLING LIQUID applied; min. 30 s and max. 60 s reaction time observed	Cylinder of VM with 5 mm diameter applied	Polymerized using 3× 180 s exposure to UV light from all sides
EDC	Surface blasted with aluminum oxide (50 µm) at 2.0 bar	Surface cleaned with oil-free and water-free compressed air	Monobond Plus primer applied; 60 s reaction time observed	Cylinder of VED with 5 mm diameter applied	Polymerized using 10 s exposure to UV light from all sides
RXU	Surface blasted with aluminum oxide (50 µm) at 2.0 bar	Surface cleaned with alcohol and oil-free and water-free compressed air	Scotchbond Universal Plus applied; reaction time of 20 s observed then dried for approx. 5 s with oil-free and water-free compressed air	Cylinder of RU with 5 mm diameter applied	Polymerized using 10 s exposure to UV light from all sides
PNV	Surface blasted with aluminum oxide (50 µm) at 2.0 bar	Substrate cleaned in an ultrasonic bath (water) and dried with oil-free and water-free compressed air	Clearfil Ceramic Primer Plus applied; dried with oil-free and water-free compressed air	Cylinder of PV with 5 mm diameter applied	Polymerized using 10 s exposure to UV light from all sides

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The total of five test groups of five specimens each were stored after the fabrication described above for 24 h in 37 °C warm water and then tested in a Zwick Universal test machine (ZwickRoell GmbH & Co. KG*) using a shear bond apparatus. The cylinders applied to the substrates were sheared off and the force required until fracture was measured.

Results
The force F that was measured was converted using the following formula to shear bond strengths (SBS) (with A = area of the cylinder):

$$SBS = \frac{F}{A}$$

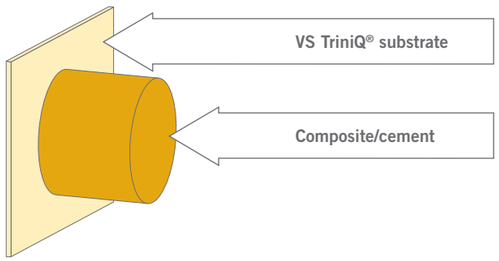

Figure 10: Setup of the shear bond test

This yielded the following mean strength values for the tested materials:

Mean shear bond strength with standard deviation

Material	Mean bond strength [MPa]	SD of the mean bond strength [MPa]
TEC	20.34	4.94
VML	17.12	2.05
EDC	20.76	3.06
RXU	24.13	6.46
PNV	16.93	8.95

Table 7: Mean shear bond strength with standard deviation (numerical)

All tested materials thus have a bond strength with VarseoSmile® TriniQ® that clearly exceeds the minimum requirement of DIN EN ISO 10477 of 5 MPa.

Conclusion
The dental composites tested in this study can be used to repair and supplement restorations made of VarseoSmile® TriniQ®. Both extra- and intra-oral corrections of the printed objects are therefore possible. It is left to the discretion of the professional user whether this is preferable to 3D printing the restoration again.
The adhesive cements tested in this study can be used to securely cement restorations made of VarseoSmile® TriniQ®. The material that can be cemented to the restoration with the adhesive cement is specified by the indication of the adhesive cement.

VarseoSmile® TriniQ® – Scientific studies

Biocompatibility

The biocompatibility is an essential feature of dental restoration materials and critical for patient safety. VarseoSmile® TriniQ® was tested extensively for its biological safety. As can be surmised from the high rate of double-bond conversions of VarseoSmile® TriniQ®, high biological safety of the material was demonstrated in the tests of biocompatibility.

Objective
Dental materials that make direct contact with patients must be biocompatible. The appropriate evidence of biological safety of VarseoSmile® TriniQ® will be demonstrated in extensive testing. In addition to tests from the DIN EN ISO 10993 series of standards, the conversion rate of double bonds, that is, the degree of polymerization after the 3D printing workflow is complete, is compared to other materials.

Method
To provide evidence of the biocompatibility, the chemical characterization as well as cytotoxicity, irritation and sensitization tests as described in the DIN EN ISO 10993 series of standards were performed. Specimens of VarseoSmile® TriniQ® were fabricated as described in the instructions for use and sent to test laboratories accredited for performing the named tests.
The conversion rate of the double bonds was also determined using an IR spectrometer (Bruker Optik GmbH*) and compared to other dental restoration materials. The double-bond conversion rate indicates the degree to which the monomers contained in the liquid material have been converted to polymers after processing in the 3D printing workflow.

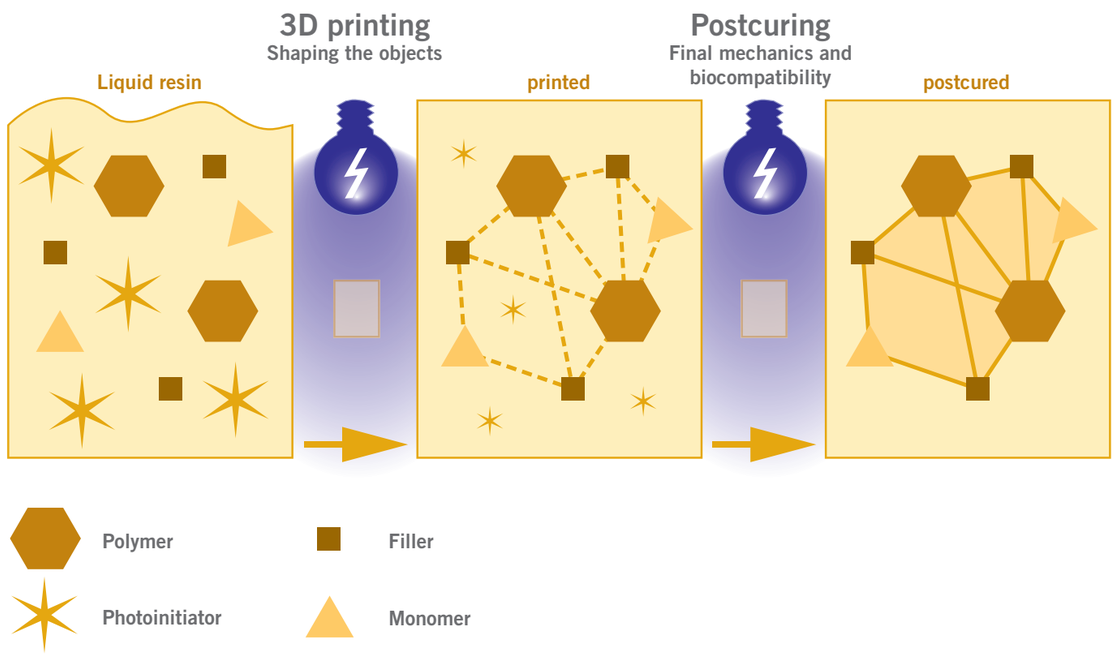

Figure 11: Polymerization during the 3D printing workflow

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Results
The results of all the biocompatibility tests that were performed confirmed the biological safety of VarseoSmile® TriniQ®.

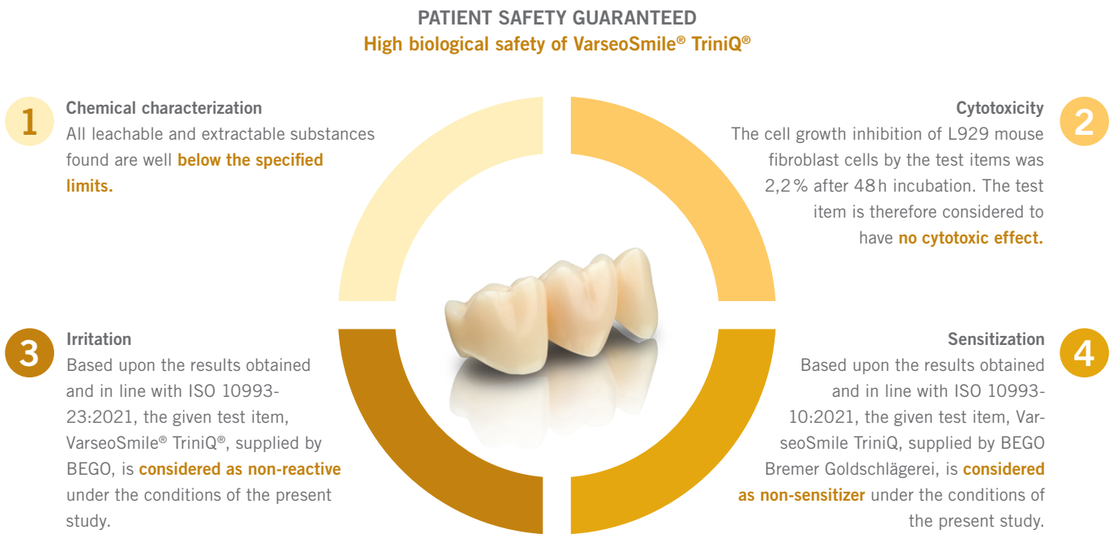


Figure 12: Results of the biocompatibility testing

The result of the determination of the conversion rate of the double bonds and their comparison with other dental restoration materials is congruent with the unremarkable result of the tests of biological safety:

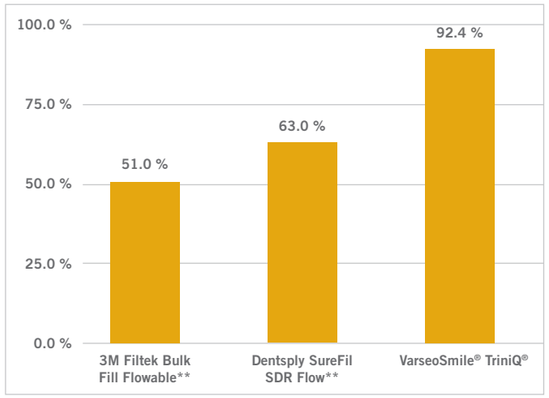


Figure 13: Conversion rate of the double bonds

Conclusion
The tests for the chemical characterization indicated that there are no additional or increased toxicological concerns. The cytotoxicity tests were also passed with no indication of toxicity for the cell line used. The product being evaluated did not cause any unacceptable, biologically harmful effects. The medical device being evaluated thus provides a very high level of biological safety that is congruent with the high double-bond conversion rate.

Bridge restoration in the posterior area with VarseoSmile® TriniQ®

Two of the many beneficial properties of VarseoSmile® TriniQ® are cost efficiency with good esthetics as well as good wear properties while also being an antagonist-friendly material. These properties were critical in this case from the dental practice of Dr. Antonio Cipressa in the treatment of a patient using a 3D-printed bridge made of VarseoSmile® TriniQ®.

Initial situation
At a check-up, it was noticed that damage in the form of chipping had occurred on an existing ceramic-veneered bridge made of non-precious metal (NPM) in region 25 to 27. The patient was no longer satisfied with the esthetic appearance of the restoration. The antagonists were also showing cracks that apparently were produced by transmission of high biting forces from the high-strength restoration onto the natural teeth.
The restoration therefore had to be replaced. For esthetic reasons, a repeat restoration with a NPM bridge was not wanted. A restoration made of lithium disilicate or zirconia was not an option due to costs. Zirconia was also contraindicated due to the high strength of the material and the condition of the antagonists.
Therefore, because of its antagonist-friendly properties (see Section 1.4 Wear behavior), the good esthetics, and the lower costs compared to a restoration made of zirconia or lithium disilicate, a restoration with VarseoSmile® TriniQ® was selected together with the patient.

Preparation
After removing the previous restoration, the abutment teeth 25 and 27 were prepared again to create the chamfer preparation that is recommended for VarseoSmile® TriniQ® with the required minimum wall thickness of 1.0 mm. Using an intraoral scanner, a digital impression was then taken of the situation prepared in this way. The dataset for the impression was sent to the Bonaca Odontotecnici dental laboratory.

Preparation of the 3D-printed bridge restoration
Using the digital image of the patient's situation, the bridge restoration was designed by the Bonaca Odontotecnici dental laboratory.

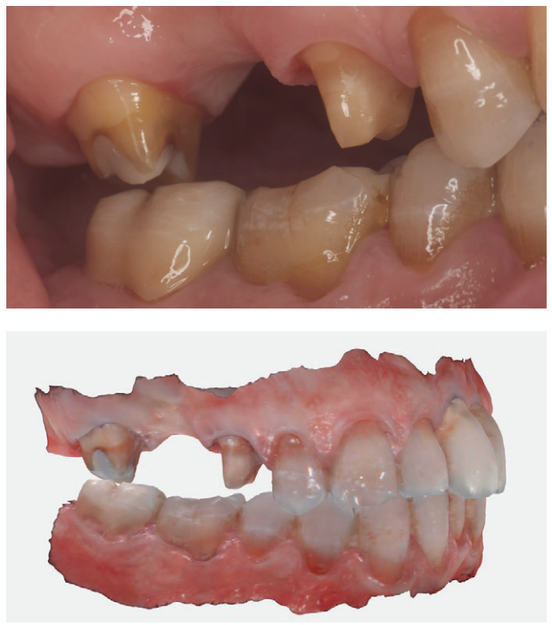


Figure 14: Prepared situation for bridge restoration

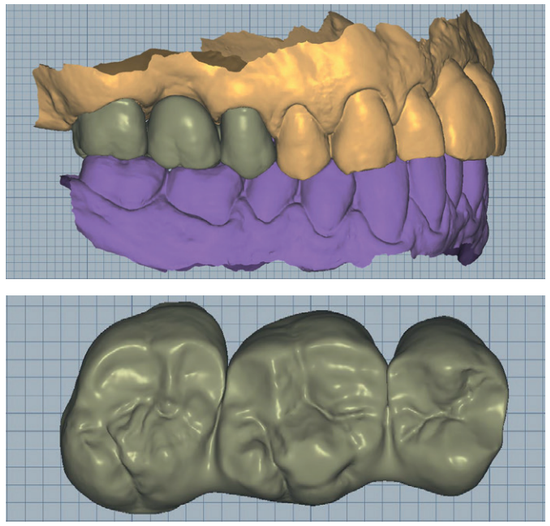


Figure 15: Restoration design in exocad*

* This symbol is a commercial designation/registered trademark of a company which is not part of the BEGO company group.
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

The dataset in STL (Standard Tessellation Language) format was then positioned virtually on the build platform in the slicer software of the 3D printer used (Varseo XS, BEGO) and the print job was then started. The printed object was cleaned to remove any remaining liquid resin and then post-cured, which gives the object its final mechanical and biocompatible properties, as described in the instructions for use from BEGO.

Figure 16: 3D printing workflow with times for VarseoSmile® TriniQ®

The tooth shade of the patient was determined to be A3.5 using the VITA Classical* shade guide. Because VarseoSmile® TriniQ® was only available in the shade A3 when the restoration was fabricated, this shade was used for the 3D printing. Using composite stains (Lite Art, Shofu*) the printed bridge was customized after removing and grinding off the support structure and the shade of the restoration was finely adjusted to A3.5. The required step of blasting the restoration that is standard for other 3D printing materials with a high ceramic content is not necessary for VarseoSmile® TriniQ®. After customization, the restoration is simply glazed and returned to the clinician.

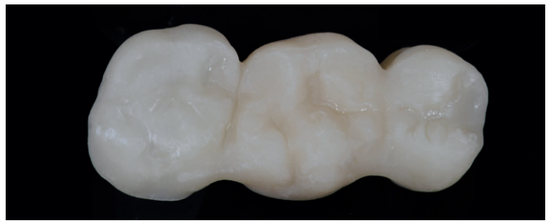


Figure 17: Completed VarseoSmile® TriniQ® restoration

Insertion

While the restoration already showed a very precise fit at the preparation margins and the contact points during the try-in, the clinician had to make slight occlusal adjustments to the bridge. To restore the required esthetic of the restoration, it was returned to the dental laboratory to apply stain and to glaze the polished areas again. The restoration was therefore not able to be definitively cemented during this appointment.

At the next appointment the restoration fit perfectly as a result of the correction and was definitively cemented into place using the Variolink Esthetik DC (Ivoclar*) adhesive system according to the manufacturer's instructions for use.

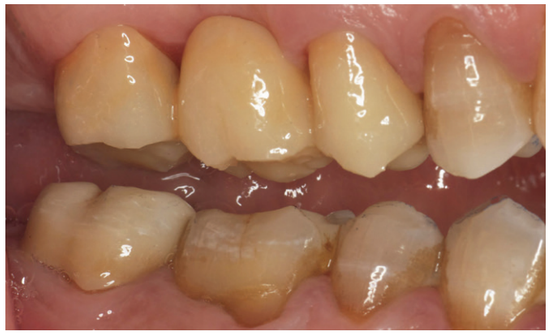


Figure 18: Inserted bridge made of VarseoSmile® TriniQ®

Both patient and clinician were very satisfied with the outcome.

Conclusion

Thanks to VarseoSmile® TriniQ®, it was possible to provide a more cost effective treatment compared to lithium disilicate or zirconia but one that was nevertheless esthetically satisfactory. VarseoSmile® TriniQ® is one of the first 3D printing materials worldwide that is approved for fabrication of definitive bridge restorations. Although this indication is substantiated by numerous in-vitro studies (see, for example, Section 1.1 Breaking load after 10-year chewing simulation) that have supported the approval of the material for this application, additional clinical data are required to boost the confidence of users in the application of VarseoSmile® TriniQ® for this indication. The collection of further clinical data and long-term clinical observation of treatments with VarseoSmile® TriniQ® such as those described here are required.

We are grateful to Dr. Antonio Cipressa from Studio Dentistico Dr. Cipressa Antonio and Alberto and Alessandro Bonaca from Bonaca Odontotecnici for carrying out and documenting this patient case.

Preparation guidelines

To ensure optimal applicability of the fabricated prosthetic restoration, the following points must be observed:

- The preparation margins must be clearly visible.
- The preparation depths for the planned restoration must have the minimum wall thickness specified below.
- A chamfer or step preparation is recommended.

In general, the preparation should be anatomically reduced. It is particularly important to ensure that there are no sharp angles or edges to avoid tensile stresses in the material. Angles and edges should be rounded before taking the digital impression using a suitable instrument such as a flexible artificial diamond disk.

The design features required for the particular restoration can be found in the instructions for use for VarseoSmile® TriniQ®.

Step preparation

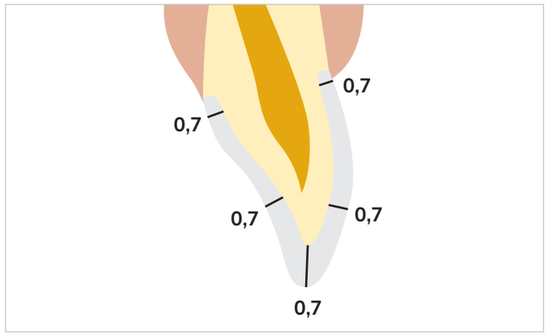
Chamfer preparation

Avoidance of sharp edges

Single-tooth restorations

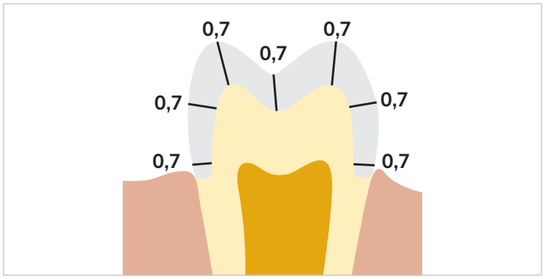
Anterior tooth crown

- Circular step preparation with rounded internal edges or pronounced chamfer preparation
- Reduce the anatomical shape while retaining the specified minimum wall thicknesses
- Width of the circular step and the chamfer min. 0.7 mm
- Reduction of the incisal edge by min. 0.7 mm
- Reduction in the vestibular or oral area by min. 0.7 mm



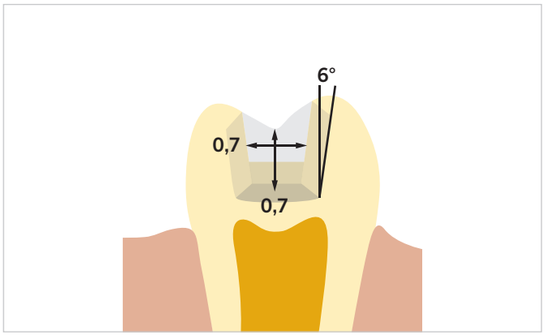
Posterior tooth crown

- Reduce the anatomical shape while retaining the specified minimum wall thicknesses
- Circular step preparation with rounded internal edges or pronounced chamfer preparation
- Width of the circular step/chamfer min. 0.7 mm
- Reduction of the occlusal surface by min. 0.7 mm
- Reduction in the vestibular or oral area by min. 0.7 mm

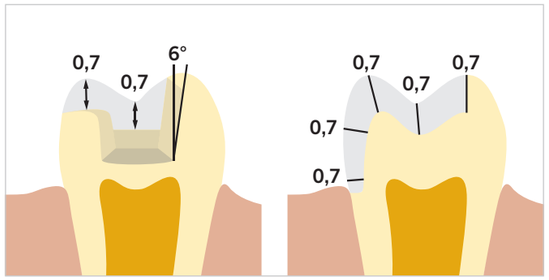


Inlay

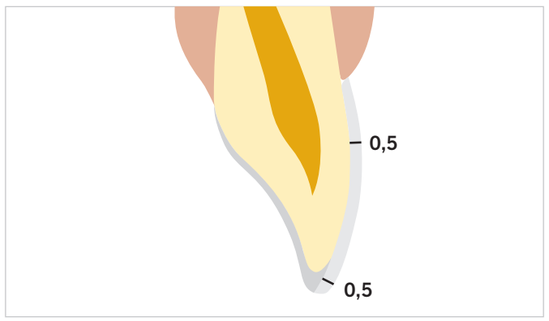
- Box-shaped preparation with no feathered margins 6° taper
- Do not place preparation margins on centric antagonist contacts
- The cavity margins must be located entirely within etchable enamel and outside the articulation contacts
- Minimum depth in the fissure floor 0.7 mm
- Isthmus minimum width 0.7 mm
- Minimum width of the proximal step 1.5 mm
- Rounded internal edges and transitions



Onlay/Partial crowns
- Consider static and dynamic antagonist contact points
- Do not place preparation margins on centric antagonist contact points
- In the fissure area ensure min. 0.7 mm preparation depth and min. 0.7 mm target width
- With the onlay, design the proximal box slightly divergent (preparation angle 6°)
- Near the cusp capping, consider min. 0.7 mm space requirement
- Circular chamfer preparation



Veneer
- Labial anatomical reduction of the hard tooth structure by 0.5–1.0 mm
- Do not locate the incisal preparation margins near the abrasion or dynamic occlusal surfaces
- Supragingival preparation
- Cervical slightly rounded shoulder, parallel to the gingival margins
- Retain proximal natural contact points
- Chamfer-type enclosure of the hard tooth structure or incisal reduction with rounded edges

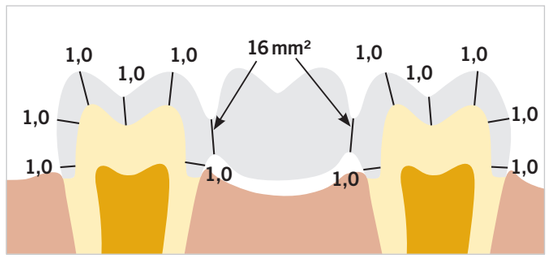


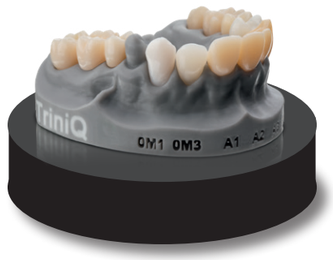
Bridge restorations

VarseoSmile® TriniQ® can be used to fabricate permanent bridges with up to three units and temporary bridges with a wear time of up to 12 months with up to seven units. The maximum bridge span is one tooth width.

Bridges in the anterior region
- Circular step preparation with rounded internal edges or pronounced chamfer preparation
- Reduce the anatomical shape while retaining the specified minimum wall thicknesses
- Width of the circular step and the chamfer min. 1.0 mm
- Reduction of the incisal edge by min. 1.0 mm
- Reduction in the vestibular or oral area by min. 1.0 mm
- When designing the bridge restoration, a minimum connector cross-sectional area of 14 mm² must be ensured

Bridges in the posterior region
- Reduce the anatomical shape while retaining the specified minimum wall thicknesses
- Circular step preparation with rounded internal edges or pronounced chamfer preparation
- Width of the circular step/chamfer min. 1.0 mm
- Reduction of the occlusal surface by min. 1.0 mm
- Reduction in the vestibular or oral area by min. 1.0 mm
- When designing the bridge restoration, a minimum connector cross-sectional area of 16 mm² must be ensured



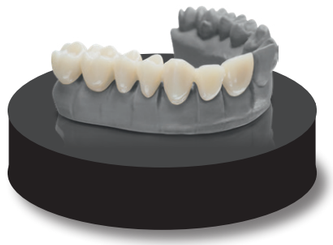


PERMANENT RESTORATIONS

- **VarseoSmile® TriniQ®** is ideal for the fabrication of single-tooth restorations, combining high material stability with aesthetically pleasing restorations at a competitive price

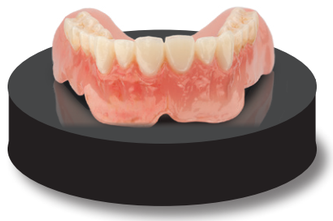
- The high strength of **VarseoSmile® TriniQ®** enables the reliable fabrication of permanent three-unit bridges

- **VarseoSmile® TriniQ®** is excellently suited for the precise and aesthetically appealing fabrication of inlays, onlays, tabletops, and veneers, allowing you to fulfill individual patient desires



TEMPORARY RESTORATIONS

- For up to seven-unit temporary bridges: **VarseoSmile® TriniQ®** is also ideal for temporary restorations, including longer bridges, providing you with flexibility in treatment planning and execution



DENTURES

- Its suitability for the fabrication of denture teeth extends the application spectrum of **VarseoSmile® TriniQ®** and highlights its versatility as a dental material

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