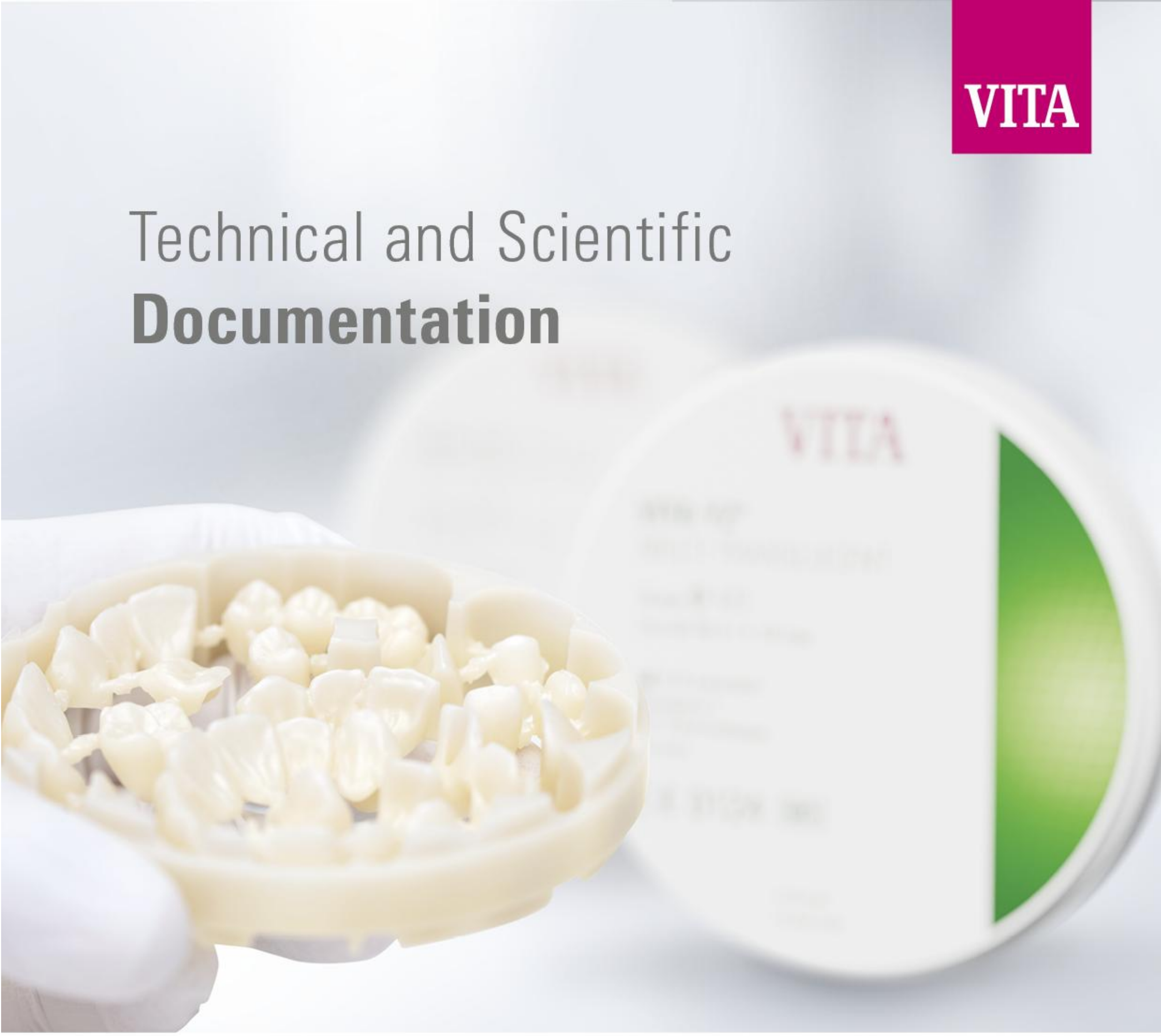
Technical and Scientific
Documentation



VITA YZ®

VITA YZ® ST Multicolor
VITA YZ® MULTI TRANSLUCENT

Content

1. Technical data VITA YZ® ST Multicolor and VITA YZ® MULTI TRANSLUCENT

1.1 Chemical composition

VITA YZ ST Multicolor are super translucent ZrO2 blanks for the fabrication of monolithic and partially veneered posterior restorations. They are characterized by a constant yttrium content of 4 mol%, which leads to consistent strength across the shade gradient.

VITA YZ MULTI TRANSLUCENT is a premium zirconium dioxide of the latest generation (4Y-TZP cervical, 5Y-TZP incisal), which combines high flexural strength with a harmonious shade and translucency gradient from the neck to the incisal edge. VITA MULTI TRANSLUCENT is used to create natural-looking restorations with convincing esthetics.

Available variants:

VITA YZ ST White (uncolored)

VITA YZ ST Color (monochrome, tooth colored)

VITA YZ ST Multicolor (polychrome, tooth colored)

VITA YZ MULTI TRANSLUCENT (polychrome, tooth colored)

Table 1: Chemical composition

Components	VITA YZ ST	VITA YZ MULTI TRANSLUCENT
ZrO_2	88 - 93	86 - 93
Y_2O_3	6 - 8	6 - 10
HfO_2	1 - 3	1 - 3
Al_2O_3	0 - 1	0 - 1
Pigments	0 - 1	0 - 2

All data in % by weight

1.2 Physical/mechanical properties

Table 1: Physical properties

Material parameter [unit]	VITA YZ ST	VITA YZ MULTI TRANSLUCENT
CTE [10^{-6}/K]	10,3	10,2
Chemical solubility [µg/cm²]	< 20	< 20
Sinter density [g/cm³]	6,05	6,05
3-point flexural strength [MPa]	ca. 1200	ca. 850 (incisal) – 1200 (cervical)
E-Modul [GPa]	210	210
Hardness [HV 10]	1300	1250
Cubic proportion ZrO_2 [%]	approx. 35	approx. 33 (cervical) up to approx. 55 (incisal)

2. 3-point flexural strength

Materials and method

Using a diamond saw, blocks were fabricated from the VITA YZ ST Multicolor and VITA YZ MULTI TRANSLUCENT blanks. Due to the yttrium gradient and its effect on the mechanical properties, the VITA YZ MULTI TRANSLUCENT test specimens were prepared from the top and bottom areas of the disc.

The test specimens were then manually ground using SiC paper (P1200 grit). Additionally, a 45° chamfer was applied to both edges of the tensile-loaded side. After sintering according to the manufacturer's instructions, the test specimens had a final dimension of 20.0 x 4.0 x 1.2 mm³. For each material, 36 specimens were loaded to failure using a universal testing machine and the average 3-point flexural strength was determined.

Results

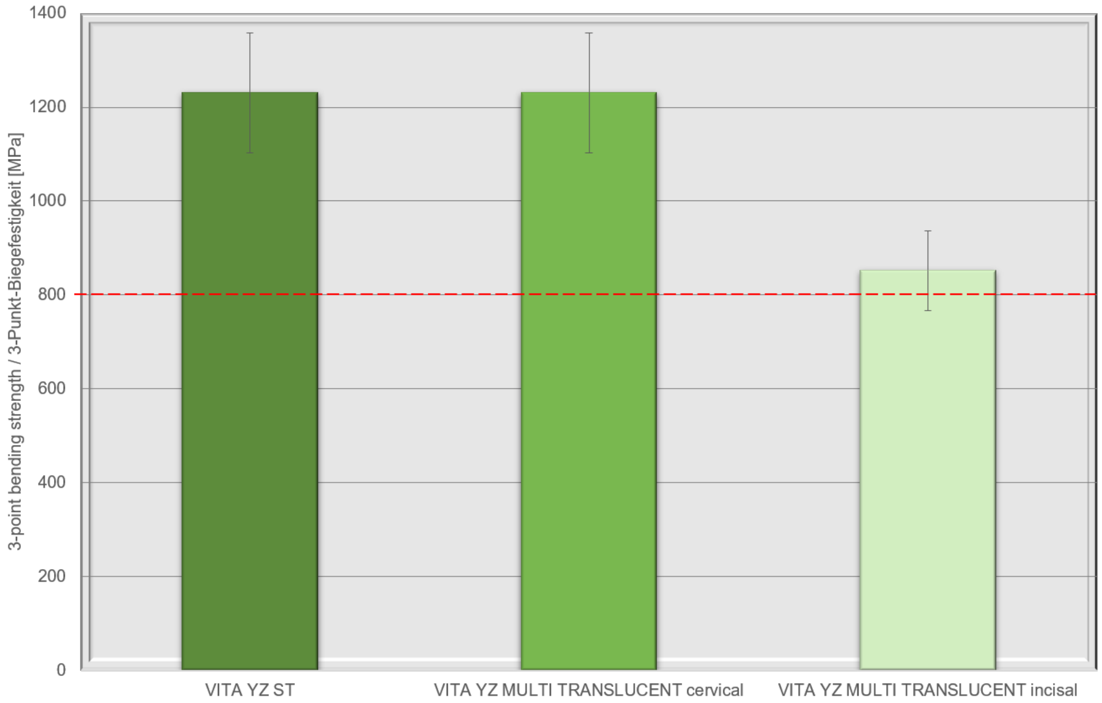


Figure 1: 3-point flexural strength

--- standard class 5 = 800 MPa
1) According ISO 6872 - 2024-12
2) Source: Internal R&D study, VITA Zahnfabrik

Conclusion

Both materials exhibit flexural strengths that easily meet the minimum requirements of ISO 6872. In the case of VITA YZ MULTI TRANSLUCENT, a strength of at least 850 MPa is achieved, even in the outermost incisal area.

3. Static breaking load with different connector cross sections

Materials and method

Three-unit posterior bridges made of VITA YZ ST and VITA YZ MULTI TRANSLUCENT were fabricated using a CAM unit and sintered according to the manufacturer's instructions.

The thinner “mesial” connector had a radius of 1.7 mm (~ 9.0 mm² cross-sectional area), the thicker “distal” connector had a radius of 2.0 mm (~ 12.0 mm²). Similarly, the bridges with an increased connector cross section had radii of 2.0 mm (“mesial”) and 2.3 mm (“distal”). All abutments had a uniform wall thickness of 0.5 mm. The bridges were attached to steel stumps using zinc-phosphate cement. For each material, six bridges with a low connector cross section and six with an increased connector cross section were loaded to failure using a universal testing machine.

Results

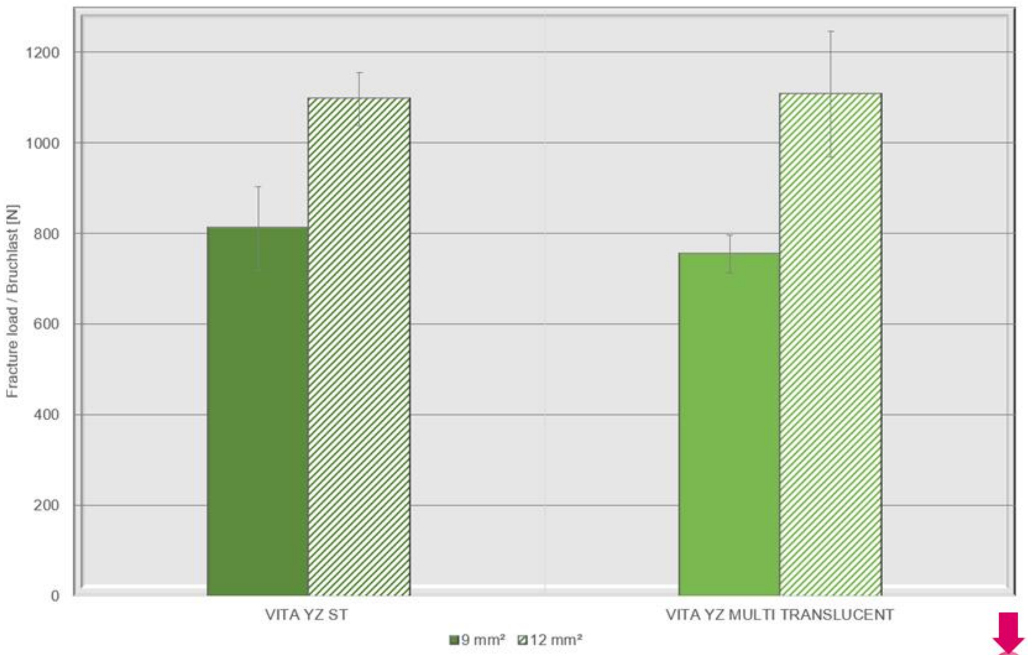
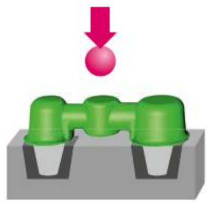


Figure 2: Breaking load with different connector cross sections



Conclusion

All mean values measured in this test - including those of the bridges with smaller connector cross-sections, were above the mean maximum masticatory force, which is given as approx. 490 N. As in the 3-point flexural test, the fracture always occurred in the area of the thinner (“mesial”) connector that was subjected to tensile stress (“gingival”).

The slight increase in the connector cross section results in a significant increase in the breaking load. It is therefore advisable to utilize the available space as fully as possible when designing the connectors in order to achieve a design with a high load-bearing capacity.

4. Static breaking load before and after hydrothermal ageing

Materials and method

In this test setup, the clinical use of the material was simulated by means of material aging in order to test its durability in the oral environment. Three-unit posterior bridges made of VITA YZ ST and VITA MULTI TRANSLUCENT were fabricated using a CAM unit and sintered according to the manufacturer's instructions. The thinner “mesial” connector had a radius of 1.7 mm (~ 9.0 mm² cross-sectional area), the thicker “distal” connector had a radius of 2.0 mm (~ 12.0 mm²). All pillars had a uniform wall thickness of 0.5 mm. Half of the samples of each material were aged for a period of 72 hours at 134 °C in steam in an autoclave. All bridges were fixed to steel stumps using zinc-phosphate cement. For each material, six aged and six unaged bridges were loaded to failure using a universal testing machine.

Results

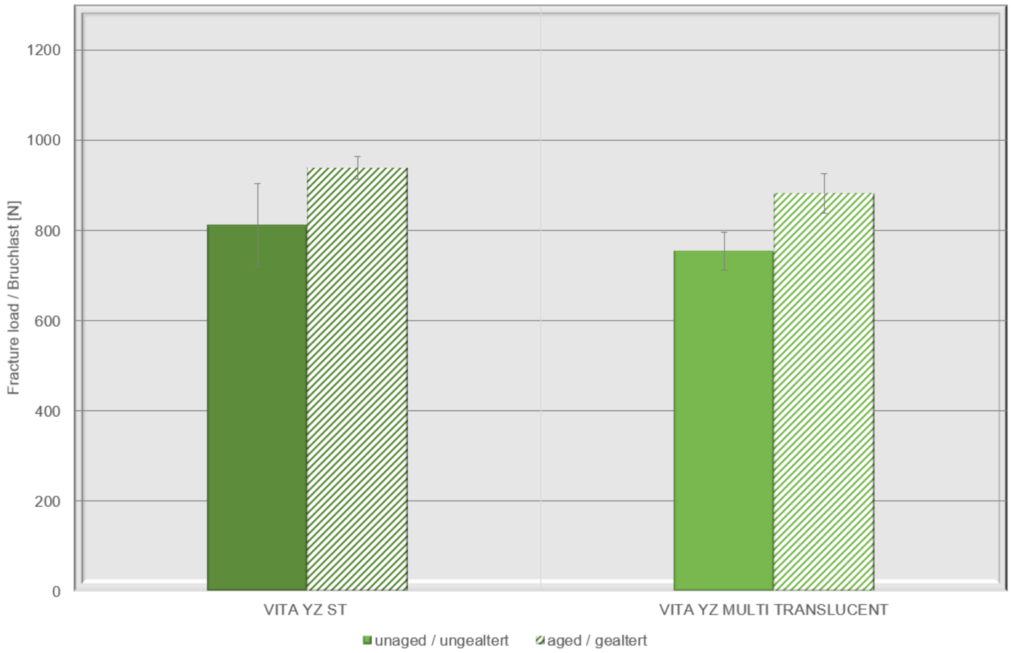
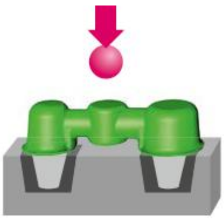


Figure 3: Static breaking load before and after hydrothermal ageing



Conclusion

The aged samples experienced an increase in strength of approx. 130 N, or the equivalent of approx. 15 %, as a result of artificial ageing. This effect is already known from earlier studies and differs from the known aging behavior of zirconium dioxide from the early years of all-ceramic restorations.

5. CAM machinability test using "VTA" geometry

Materials and method

To better evaluate the CAM processability and the reproduction accuracy of the virtually designed marginal areas of the different VITA YZ variants (ST and MULTI TRANSLUCENT), four "VTA specimens" (Vulnerable Test Area, cylindrical specimen geometry with four thin wall areas, see figure on the left) with wall thicknesses of 0.2 mm or 0.3 mm or 0.4 mm or 0.5 mm were fabricated for each variant using a CAD/CAM unit. The same milling strategy was used for all samples. Finally, the sample geometries in the four wall thicknesses were visually inspected and the walls of the respective samples were examined for defects. The results graph shows the "success rate" per sample geometry for each material variant and wall thickness.

Results

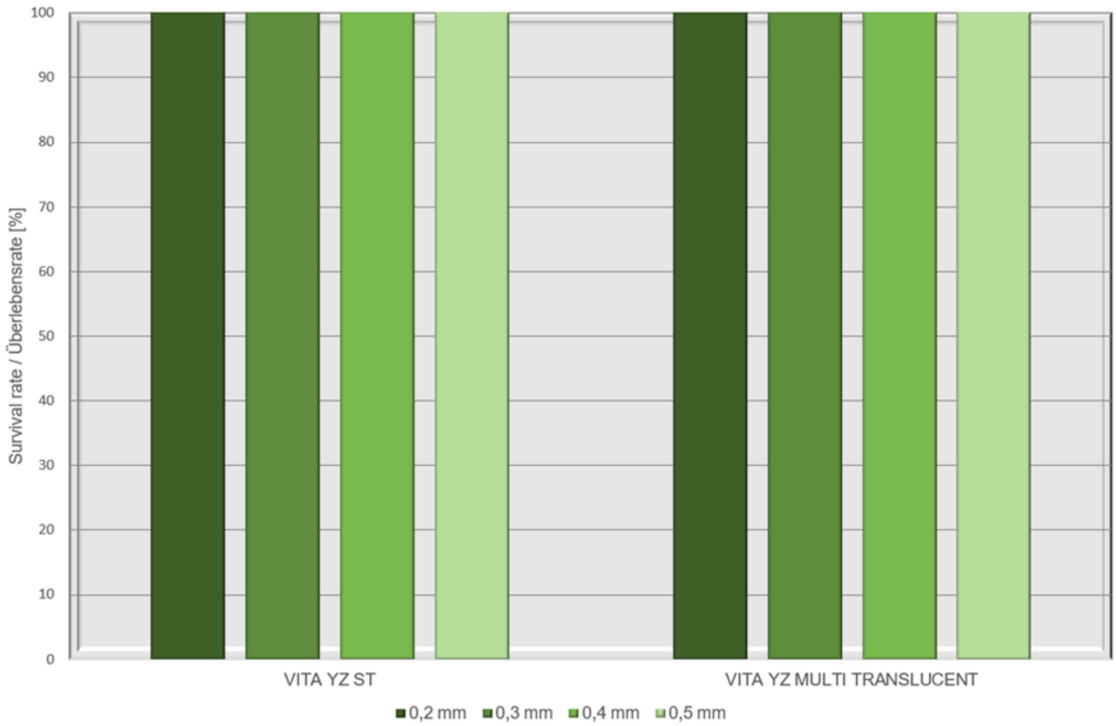
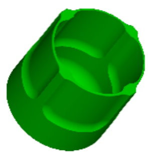


Figure 4: Survival rate of merlons with different wall thicknesses



Conclusion

In the test setup in accordance with ISO 18675, the two materials tested did not show any edge chipping. Even with wall thicknesses of 0.2 mm, the survival rate is 100%. The tests were carried out using a validated template for crowns, which is approved 1:1 for the standard milling process in this form.

6. Influence of CAM machining on load capacity

Materials and method

In order to investigate the influence of CAM processing (e.g., through different milling strategies) on the load-bearing capacity of bridges, posterior bridges made of VITA YZ MULTI TRANSLUCENT were milled using three different CAD/CAM systems and sintered according to the manufacturer's instructions. The thinner "mesial" connector had a radius of 1.7 mm (~ 9.0 mm² cross-sectional area), the "distal" connector had a radius of 2.0 mm (~ 12.0 mm²). The caps had a uniform wall thickness of 0.5 mm. All bridges were fixed with zinc-phosphate cement on a steel stump. For each CAD/CAM system used, six bridges were loaded to failure using a universal testing machine.

Results

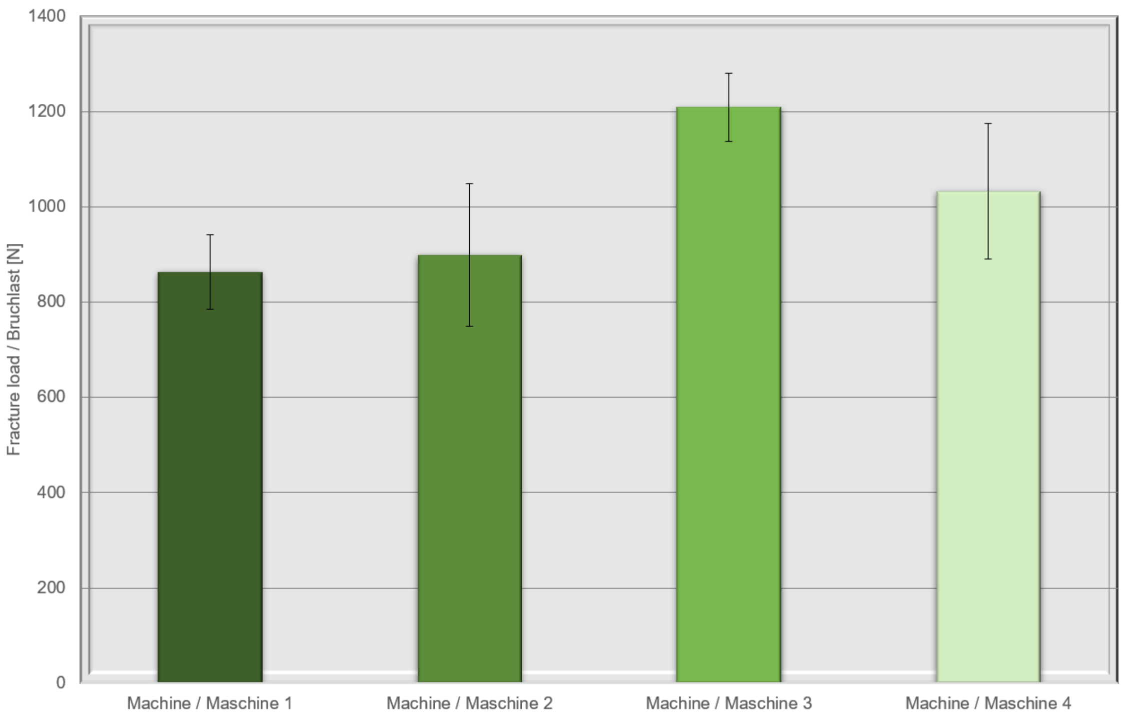


Figure 5: CAM machining

Conclusion

All four systems tested (machine + CAM software) deliver breaking load values above 850 N in this test setup. Nevertheless, the investigation shows that different tools and/or milling strategies can have a significant influence. Although the standard process was always selected, increases of approx. 30 % are possible.

Basic recommendations for the machining of zirconium dioxide can also be found at: [Downloadcenter. Productinformation.]

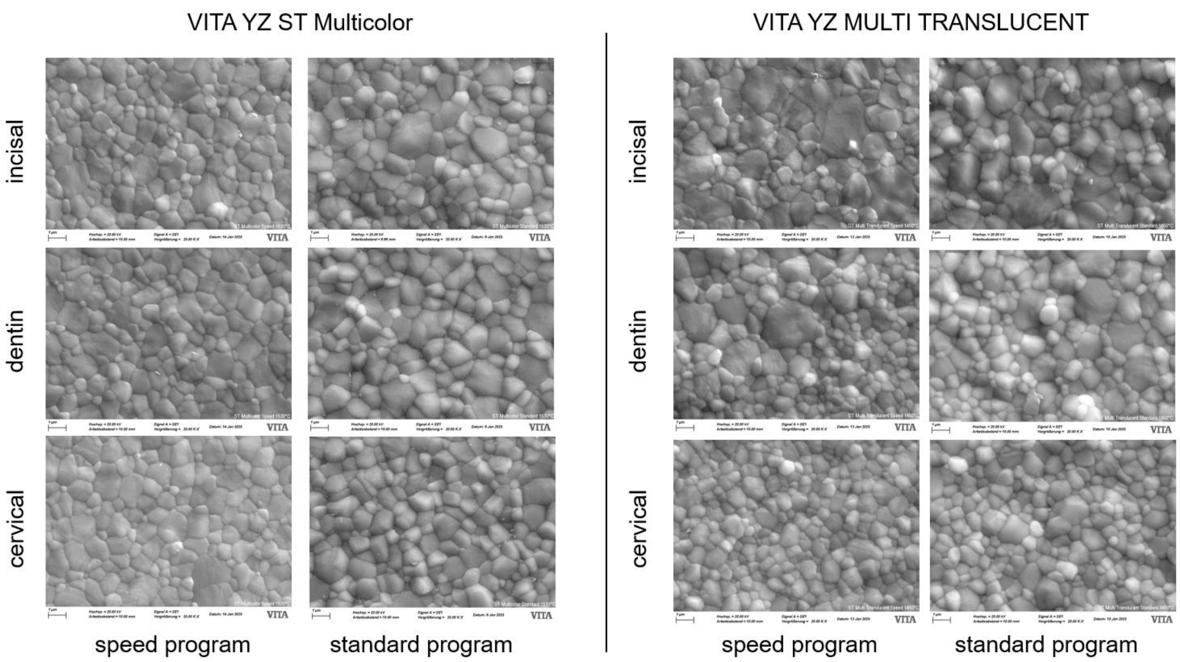
7. Microstructures and crystal structures

Materials and method

For direct comparison, samples made of VITA YZ ST and VITA YZ MULTI TRANSLUCENT were sintered at a maximum temperature of 1450 °C. The temperature was maintained for two hours. The microstructures were then analyzed using a scanning electron microscope (SEM). The VITA YZ MULTI TRANSLUCENT material was examined at five different points, each corresponding to the exact center of the associated layers (layer five = cervical area to layer one = incisal area).

The microstructures of the materials VITA YZ ST and VITA YZ MULTI TRANSLUCENT are shown in comparison below. Here, both materials were examined in identical areas that were located as far as possible in the incisal area (1 mm below the upper edge), in the middle and as far as possible in the cervical area (1 mm above the lower edge). Microstructurally, this can be recognized by a higher proportion of larger grains in the microstructure. Analytically, the proportion of cubic modification was determined by X-ray diffraction. In the case of VITA YZ MULTI TRANSLUCENT, measurements were carried out on the individual layers. No different areas were measured for VITA YZ ST, as it does not show a pronounced Y2O3 curve and the ratio of tetragonal to cubic modification remains constant.

Results



Proportion $c\text{-}ZrO_2$	VITA YZ ST	VITA YZ MULTI TRANSLUCENT (incisal)	VITA YZ MULTI TRANSLUCENT (cervical)
standard program	35	55	33
speed program	32	56	34

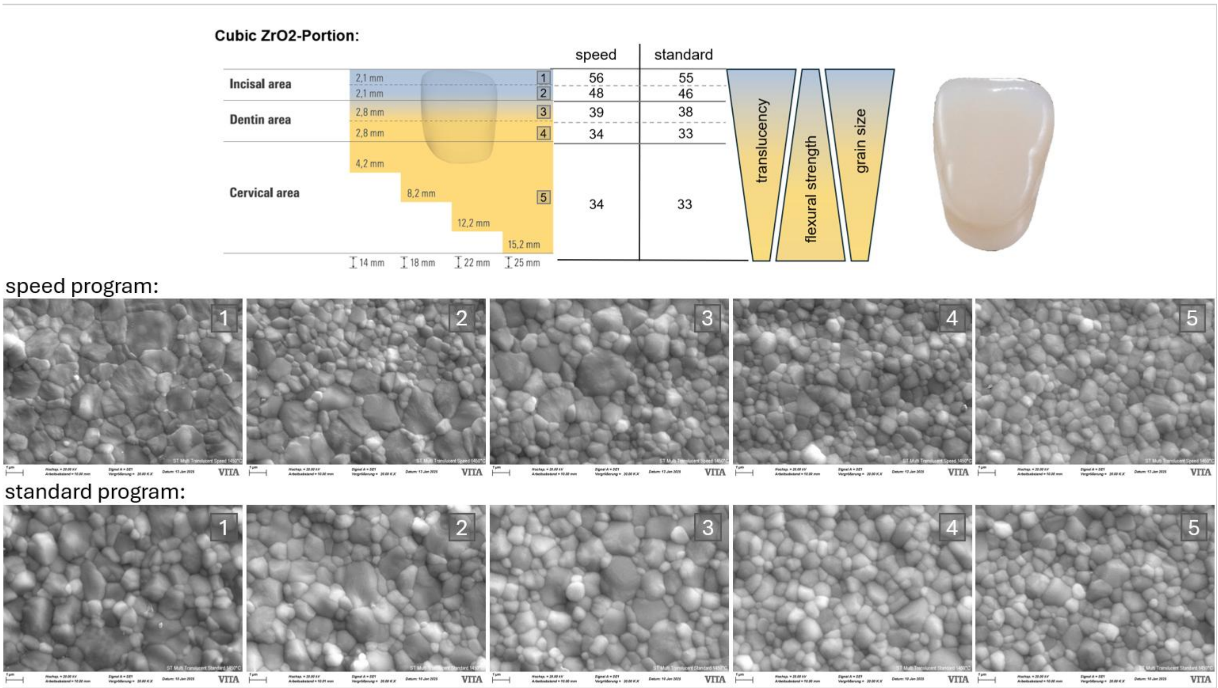


Figure 6: Microstructure and crystal structures along the circular blank height

Conclusion

With increasing Y2O3 content, the proportion of cubic ZrO2 modification in the ceramic increases, which causes an increase in translucency, but a decrease in flexural strength.

In the case of VITA YZ ST, the speed-sintered samples generally show a finer-grained microstructure with a grain size reduced by approximately 100 nm, compared to the standard-sintered samples. The evaluation of the X-ray analysis revealed a slightly reduced proportion of cubic modification after speed sintering. Based on these observations, speed sintering for VITA YZ ST is limited to smaller restorations.

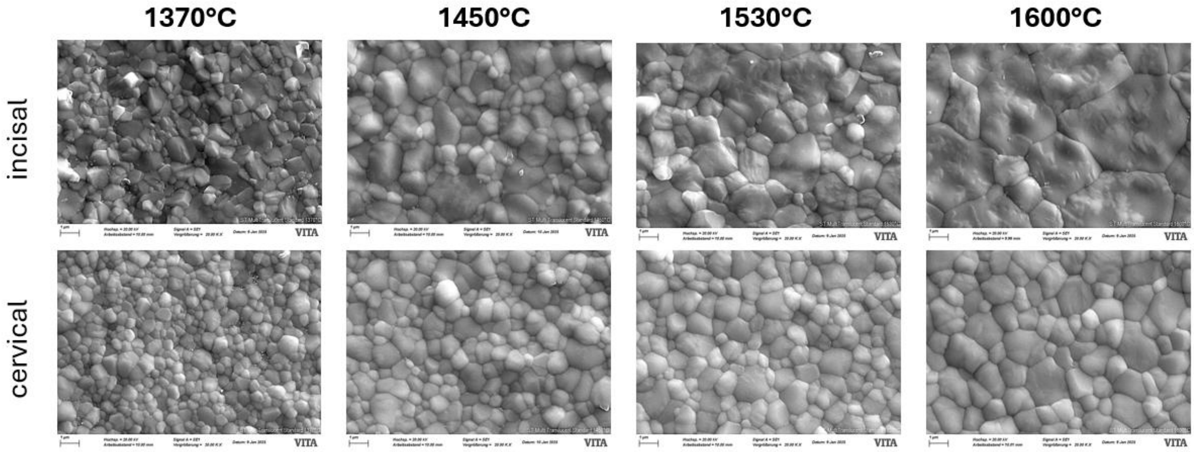
The measurements on VITA YZ MULTI TRANSLUCENT do not indicate any significant differences between speed-sintered and standard-sintered samples. The microstructure shows an almost identical grain size for both sintering programs, which increases with greater Y2O3 content in the direction of the incisal edge. This increase is most pronounced in the case of the cubic grains. The relative proportion of the cubic ZrO2 modification increases significantly in the direction of the incisal layers, creating a natural translucency gradient and making the color gradient appear even more harmonious. As there are no differences even in the incisal area, speed sintering is not subject to any restrictions in the case of VITA YZ MULTI TRANSLUCENT.

8. Influence of sintering temperature

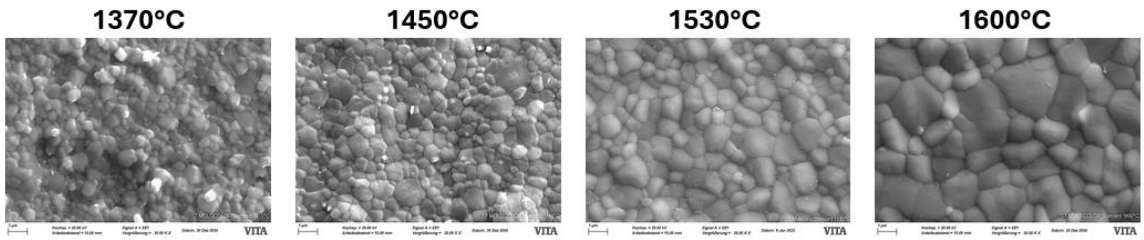
Materials and method

The influence of the sintering temperature on the particle size is known from studies by Piconi. If the temperature is too low, the structure cannot be completely sintered. If the temperature is too high, the material tends to grow grains. Such temperature deviations have both an optical and mechanical effect on the final result. Materials that are sintered too low appear opaque. Materials sintered at a too high temperature appear translucent but generally have reduced mechanical properties. For a direct comparison, samples made of VITA YZ ST and VITA YZ MULTI TRANSLUCENT were sintered at a maximum temperature of 1370 °C, 1450 °C, 1530 °C and 1600 °C. Each temperature was maintained for two hours. The microstructures were then analyzed using a scanning electron microscope (SEM).

Results



VITA YZ MULTI TRANSLUCENT



VITA YZ ST Multicolor

Figure 7: Influence of the different sintering temperatures on the microstructure and crystal structures

Conclusion

Pure 4Y material (VITA YZ ST Multicolor) shows no differences in the microstructure between the incisal and cervical areas. The grain size increases with rising temperature, but there is no big grain growth up until 1600°C.

In the case of VITA YZ MULTI TRANSLUCENT, differences in terms of significantly larger grain sizes in the incisal area are recognizable at all temperatures. In the incisal area, significant grain growth can be observed at temperatures above approx. 1530°C, which is typically accompanied by decreasing flexural strength.

Regarding the proportion of cubic modification, a temperature dependence can be seen for both the 4Y and the 5Y material. In both cases, the cubic proportion increases with rising temperature. In combination with the previously described dependence of the grain size, this results in a rising in fading of the color effect with rising temperature. Conversely, samples sintered at a too low temperature generally appear too chromatic compared to the benchmark.

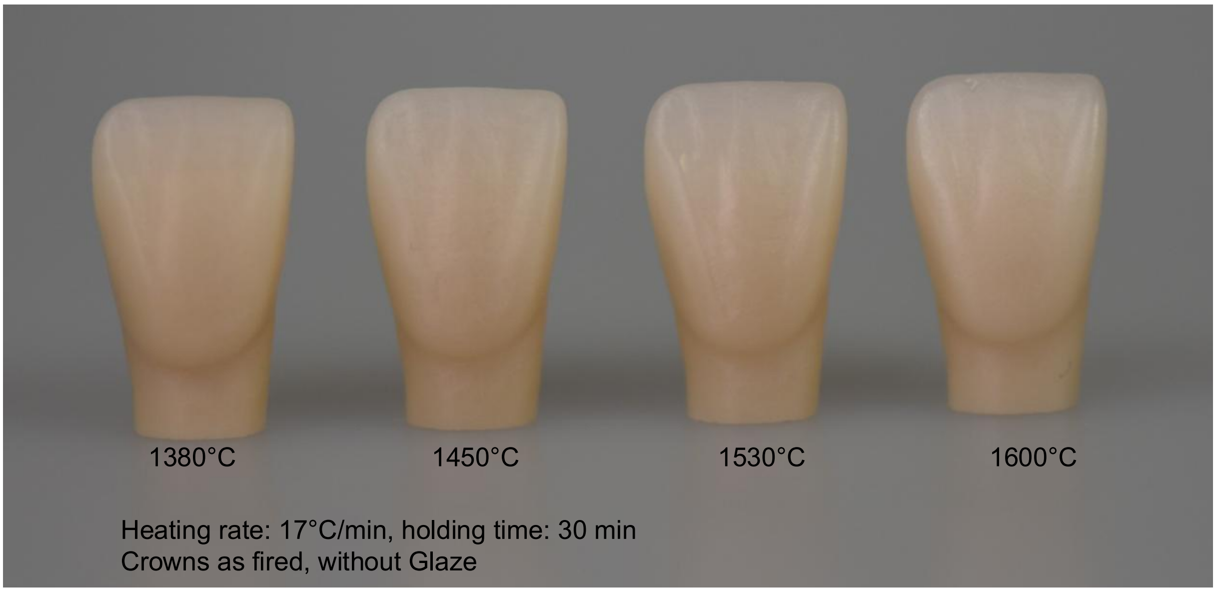


Figure 8: VITA YZ MULTI TRANSLUCENT at different sintering temperatures, unglazed

9. Fitting after the sintering process

Materials and method

Various restorations were designed on the basis of a digital model (CAD design). The corresponding model was then milled out of aluminum using a CNC machine. The same machine was used to enlarge the respective restorations, taking into account the corresponding sintering shrinkage. In this way, possible measurement inaccuracies that could arise from a scanning process could be excluded. Finally, the fit of the sintered constructions was examined visually and haptically using a model, and virtually by overlaying the digital and real constructions using wrap software.

Results

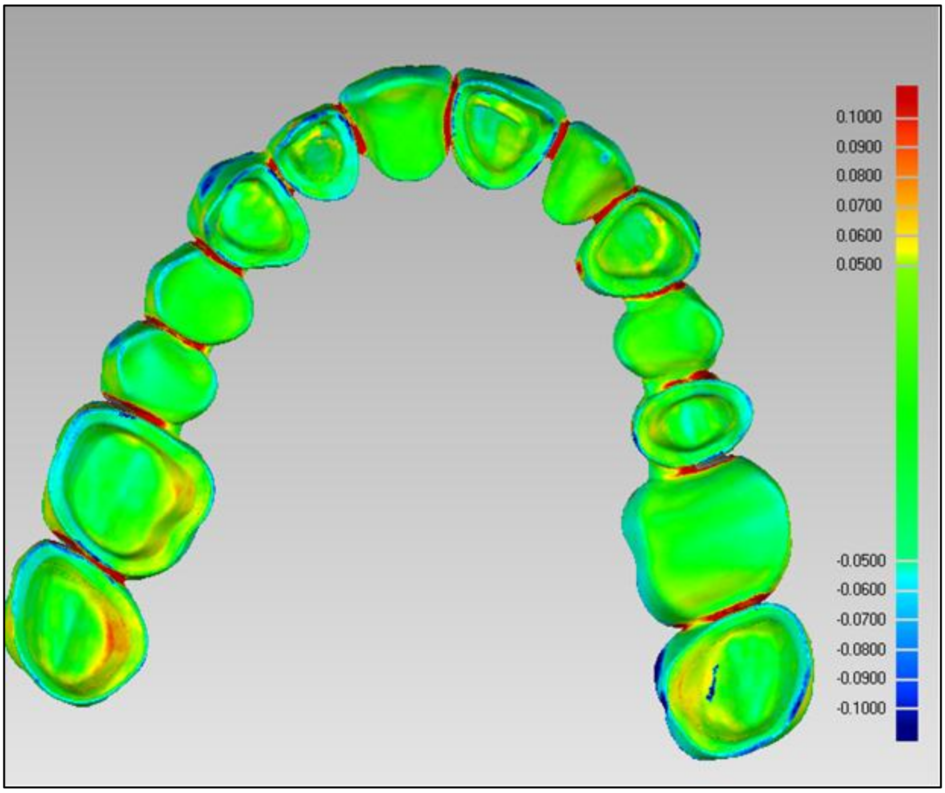


Figure 9: Superimposition of the 3D data with the scan of the bridge

Conclusion

The 14-unit, fully anatomical maxillary bridges can be separated from the sinter support without stress and show no interfering contacts during the fit check on the aluminum model. The overlaying of the scan with the 3D data of the STL file also shows a match of ± 50 μm and is therefore within the usual cement gap.

10. Influence of polishing

Materials and method

It is already known from previous tests with veneered and polished crowns made of VITA YZ T that a well-polished zirconium dioxide surface does not cause significant abrasion on a steatite antagonist (see 10160D, page 28). As a result, polishing of contact points is always recommended to avoid damage to the antagonist if the glaze is abraded during the clinical course.

Polishing is always recommended if ceramic restorations have to be subsequently milled. Otherwise, grinding grooves may lead to initial crack growth.

Polishing the entire zirconium dioxide surface is possible as an alternative to glazing.

Results

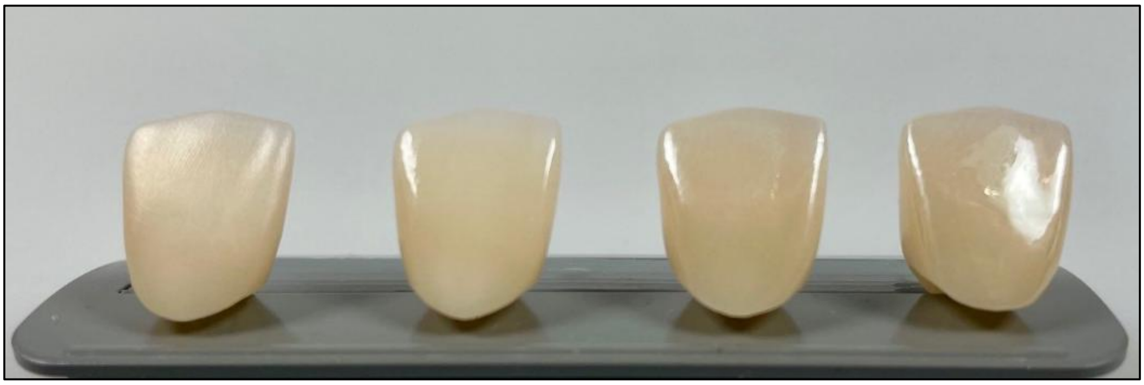


Figure 10: left to right AM-processed only, glazed, brushed with polishing paste and polished

Conclusion

The pearlescent effect in polished zirconium dioxide is created by a combination of physical phenomena that scatter and reflect light in a unique way. Polished zirconium dioxide has a very fine surface structure at the nanometer scale. This structure causes light scattering, which leads to the characteristic shimmering effect.

VITA YZ®

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