Final Report Bending Strength Zirkonzahn-Investigation

1. THE MATERIAL

Zirconium oxide has delivered an optimal performance as framework material in dentistry since more than 10 years. For the first time, this material enables to produce also long-span bridges in the lateral tooth region. As zirconium oxide is a white material and/or can be coloured with colouring solutions similar to dentin, a clear aesthetical improvement can be attained in comparison to metal-ceramic veneering.

2. EXPERIMENTAL SETUP:

All samples examined were processed with the biaxial fracture test according to ISO 6872. Circular test pieces made of non-coloured zirconium oxide, sintered zirconium oxide coloured according to instructions and coloured, high-speed sintered zirconium oxide have been ground plane parallel as in the test description with 40 μ m and 20 μ m granulation. The samples showed a diameter of 16 mm and a thickness of 1.2 mm. The check of these parameters was carried out at two (diameter) or nine (thickness) points. Subsequently, all of the test pieces were loaded, similarly to the biaxial fracture test, until fracture occurred, using a universal testing machine (Zwick/Ulm) and the values obtained were written down. The feed rate of the testing machine was 0.5 mm per minute.

From the cullet values won so the bending strength and of the Weibull then could-m are calculated for module. In such a way, the bending strength and the Weibull module m could then be calculated from the acquired fracture values.

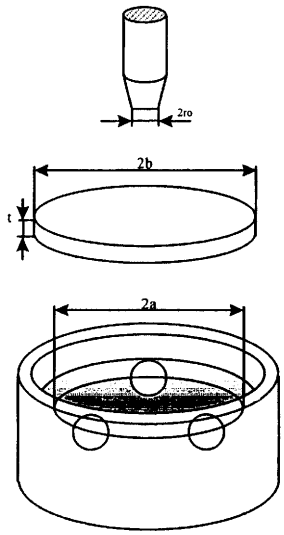

Fig. 1: Experimental setup of bioaxial fracture test

Sampling:

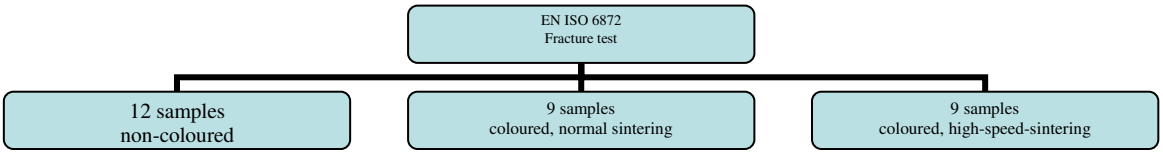

Fig.2.: Distribution of samples examined

The evaluation is carried out with the statistics program SPSS 13.0 (SPSS Inc., Chicago/U.S.A.) in the form of descriptive statistics and the parameter-free test according to Mann-Whitney.

3. RESULTS:

a) Initial resistance:

The samples made of non-coloured zirconium oxide with a mean average value of 1565,28 MPa (+/- 123,89)and a Weibull module m=15,84 the lowest average bending strength. The coloured zirconium oxide sintered with the normal program provides an average bending strength of 1642,78 MPa (+/-103,88) with a Weibull module of 17,37. The high-speed sintered zirconium oxide reaches an average bending strength of 1622,77 MPa (SD 223,81) and a m-value of 14,28.

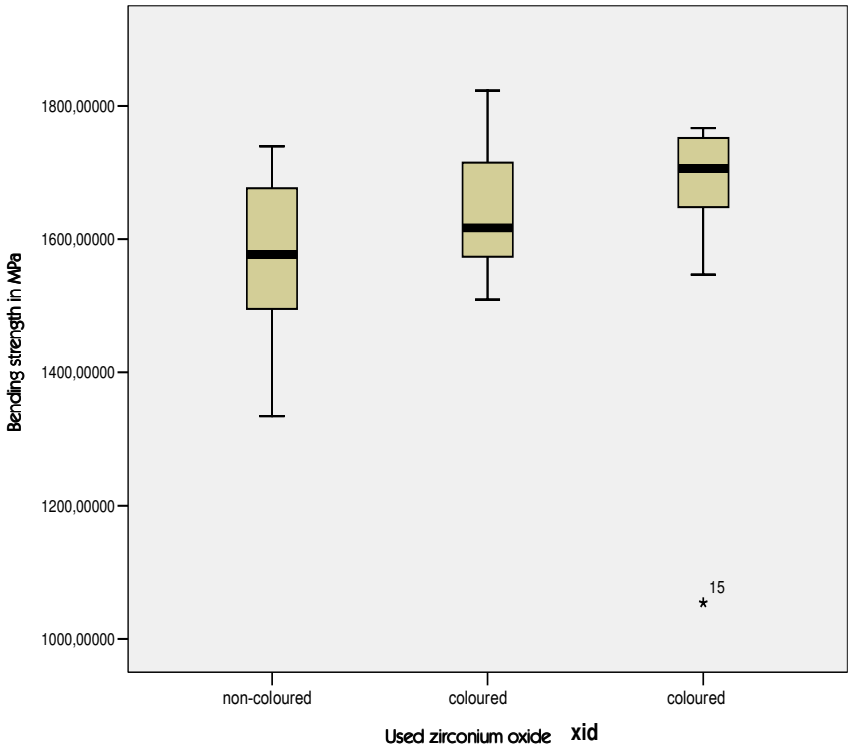

Fig. 3 : Initial resistance of samples examined (on the left: non-coloured zirconium oxide, center: coloured zirconium oxide, normally sintered; on the right: coloured high-speed-sintered zirconium oxide).

The black bar shows the median value (not the average value).

Statistical evaluation

The parameter free test according to Mann-Whitney was used for a statistical comparison of the individual groups of samples. If this test provides values inferior to p = 0.05, we talk of statistically significant differences.

Based on the null hypothesis "the zirconium oxide samples examined do not differ in the bending strength", this is fulfilled for high-speed sintered zirconium oxide with values of p=0,219 (Comparison with normally sintered and coloured zirconium oxide) and p=0,069 (Comparison with non-coloured zirconium oxide). The comparison between normally sintered, non-coloured against coloured zirconium oxide with p=0,546 also provides no statistically significant differences.

4. SUMMARY:

All of the samples deliver very high values for zirconium oxide processed pre-sintered blocks (blanks). The statistical differences must be evaluated carefully for the number of the samples examined, however the shortening of the sintering time, does not seem to have a negative influence on the bending strength of zirconium oxide. In order to be able to calculate the Weibull parameter m, the number of samples should be increased to 15-20 per group. An artificial ageing of the samples by mechanical and thermal load alternations will further round off the examination.

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sgd.

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