

8 Summary

Methods conforming to DIN 13 914:1987 and DIN EN ISO 3336:1996 to test the bond strength between resin teeth and denture base resin have been evaluated.

The quantitative 3-point bending test conforming to DIN 13 914 was in force in Germany until it was substituted in 1996 by the qualitative tensile test conforming to DIN EN ISO 3336.

Two types of resin teeth and a heat cured denture base resin were used. The bond strength test according to DIN 13 914 was tested with 161 specimens. Parameters of producing and testing were modified in accordance with the formulated questions. For the DIN EN ISO 3336 bond strength test a total number of 72 specimens was produced and tested without any modification, in accordance with the directions of DIN EN ISO 3336. All specimens were tested with a crosshead speed of 1 mm min^{-1} until fracture occurred. Maximum forces [N] were recorded. The fracture lines were recorded and classified. U-test according to MANN-WHITNEY was used for statistics.

The DIN 13 914 bond strength test was investigated concerning its sensitivity to flaws, its reproducibility, its validity and its discriminatory power.

As sources of errors were taken into account inadmissible angles between the interface and the specimens' cross section which emerge from inaccurate specimens' manufacture as well as an off-centre load. The frequency of adhesive fractures and hence the validity decreased in relation to the increase in angle. Off-centre positioning partly caused distortion of measurements. Thus, the DIN 13 914 bond strength test is fault-prone in terms of improper specimen production and during implementation. Yet faults are widely avoidable by simple measures.

Reproducibility was investigated by means of influence exerted by the parameters of specimens' production, which are poorly defined by DIN 13 914. These parameters are the specimens' cross section size, the extent of milling, which means the amount of resin to be removed when roughening the base of the teeth and the type of hard metal milling cutter which has to be used for it.

Since variations of these parameters showed no influence on test results, a good reproducibility is to be expected.

It has been proved that the high rate of adhesive fractures is an expression of high validity. Exactly if the fracture occurs at least partly adhesive, which means that the fracture line follows at least partly the interface, the bond strength affects the result and a valid measurement has to be assumed. So, the validity of each single measurement can be verified by a simple visual inspection of the fracture line. Thus, single measurements, which are recognized as not valid due to total cohesive fracture, can be eliminated. In this way the validity of the entire test method can be improved.

The discriminatory power of DIN 13 914 bond strength test was sufficient to reveal the different bond properties of the two types of resin teeth.

The bond strength test according to DIN EN ISO 3336 was investigated concerning its validity and its discriminatory power.

It has been proved that the low rate of adhesive fractures is an expression of deficient validity. The test design induces cohesive fractures by determining the location of a fracture in the area of the weak incisal part of the tooth, which is some distance from interface that is to be tested. Thus bond testing according to DIN EN ISO 3336 has an inherent and serious methodical flaw. It measures bond strength in relation to the strength of the incisal part of the tooth, while the latter remains unknown because a strength test of the tooth itself is not part of DIN EN ISO 3336. This fact causes a success of a tested tooth product, because its incisal parts are very weak or a failure of a tested tooth product, because its incisal parts are very strong.

The discriminatory power of DIN EN ISO 3336 bond strength test was not sufficient to reveal the different bond properties of two types of resin teeth.

Apart from expense, the DIN 13 914 testing method is clearly superior to the DIN EN ISO 3336 testing method in every respect. The substitution of the DIN 13 914 by the DIN EN ISO 3336 should be reversed in view of the shortcomings of the latter, which makes an appropriate quality assurance difficult to achieve.