Marginal Adaptation of Cerec Ceramic Veneers after Cementing with Different Materials

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Summary

The aim of this study was to analyze the quality of marginal adaptation and gap width of Cerec ceramic veneers after cementation with two different materials (Tetric and Compolute). The study was carried out on 24 teeth, divided into groups of 12 on which ceramic veneers were fabricated. The first 12 veneers were cemented with a composite material with microparticles (Tetric) and the other 12 using dual composite cement (Compolute). The samples were cut in the vestibulooral and mesiodistal direction and analyzed with an OPTON SV 8 stereomicroscope, with 160x magnification. Ideal adaptation of veneers after cementation with Tetric occured in 97.9% and good in 2.1% of cases. In the group cemented with Compolute ideal adaptation was determined in 95.8% and good in 4.2% of the samples. In neither group was poor adaptation established. In samples cemented with Tetric in vestibulooral direction complete adaptation was observed in 39.6%, negative adaptation in 43.8% (veneer was not completely seated on the cavity wall), and positive in 16.7% of the samples (veneer was higher than the surface of the prepared cavity). In the mesiodistal direction complete adaptation was recorded in 45.8% of the samples, negative in 39.6% and positive in 14.6%. After cementation with Compolute in the vestibulooral direction ideal adaptation was established in 51.1%, negative in 38.3% and positive in 10.6% of cases. In the mesiodistal direction complete adaptation was recorded in 52.1%, negative in 45.8% and positive in 2.1%. Difference in the quality of veneer adaptation in the vestibulooral and mesiodistal direction was not significant. Mean value of variations in the vestibulooral direction amounted to negative 493.80 μm and positive 388.96 μm. Mean value of variations in the mesiodistal direction amounted to negative 411.70 μm and positive 347.63 μm. Mean gap width after cementation with Tetric in the vestibulooral direction was 247.69 μm, and in the mesiodistal direction 156.56 μm. For the veneers cemented with Compolute mean gap width was 257.62 μm in the vestibulooral and 169.08 μm in the mesiodistal direction, which was not significant. The obtained results indicate that both materials are suitable for cementation of Cerec ceramic veneers.

Key words: *Cerec CAD/CAM, ceramic veneers, marginal adaptation, gap width.*

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Introduction

The therapeutic method of fabricating veneers on labial surfaces of the teeth involves aesthetic and functional components, with minimal destruction of labial surfaces (1). Indications for fabrication of labial veneers are primarily restoration of fractured teeth, correction of discoloration, correction following orthodontic treatment and various other reasons for aesthetic correction of the labial surfaces of frontal teeth (2-8). The Cerec system enables fabrication of ceramic veneers by application of CAD/CIM technology. The advantages of this procedure are its simplicity. Namely, laboratory work is unnecessary, there is no classic impression procedure and it is possible to fabricate several veneers during one appointment (8-12). Most often micro-hybrid dual composite cements are used for cementing veneers fabricated by the CEREC system, which enable fluorescent and chemical polymerization. Apart from dual composite cements fluorescent polymerising micro-hybrid composite materials can also be used (8, 13-15).

The aim of this study was to determine the degree of marginal adaptation and gap width of veneers fabricated by the CEREC system, after cementing with fluorescent polymerising micro-hybrid composite material and dual micro-hybrid composite cement.

Material and methods

The study was performed on 24 extracted teeth (first premolars, incisors and canines) on which labial veneers were fabricated. Ceramic blocks CEREC VITA MARK II (Vita Zahnfabrik, Bad Säckingen, Germany) were used for fabricating the veneers. Preparation of cavities for fabrication of veneers was carried out according to the principles of cavity fabrication for Cerec fillings (Cerec system), and in accordance with the instructions of the manufacturer, manually. Prior to taking the optic impression the prepared surfaces for fabrication of the veneer were covered with Cerec powder which prevents light reflection and enables optimal contrast. Cerec 2 CAD/CAM system was used for fabricating the veneer (Cerec 2, software C.O.S. 4.21, Siemens AG, Bensheim, Germany).

Veneers were divided into two groups of 12 veneers. The first group was cemented with a composite material with microfiller Tetric (Vivadent, Schaan, Liechtenstein) and adhesive system 5th generation Syntac SC (Vivadent, Schaan, Liechtenstein). The second group was cemented with dual composite micro-hybrid cement, used for cementing inlays and veneers, Compolute (3M Espe, Seefeld, Germany) and adhesive system 4th generation EBS Multi (3M Espe, Seefeld, Germany).

The method of cementing veneers by hybrid composite material with microparticles (Tetric) included preparation of the cavity by completely etching with 37% orthophosphoric acid for 20 seconds. After etching the cavity surface was rinsed with water for 20 seconds and then dried. Adhesive system Syntac SC was applied and illuminated for 20 seconds. The procedure was repeated in accordance with the manufacturer's instructions. The ceramic veneer was etched with 5% hydrofluoric acid (CEREC CERAMIC ETCH, Vita Zahnfabrik, Bad Säckingen, Germany) for 60 seconds. After rinsing with water the silan bond was applied with a brush (Monobond S, Vivadent, Schaan, Liechtenstein) for 60 seconds. The hybrid composite material Tetric with microparticles was introduced into the cavity and the veneer was pressed into the cavity with an ultrasound extension. Excess material was removed with an instrument. After which the material was polymerized incisally for 40 seconds, mesially and distally for 40 seconds, and buccally and lingually (palatinally) for 40 seconds.

Preparation of the cavity for cementing with dual composite cement Compolute (3M Espe, Seefeld, Germany) commenced by completely etching with 37% orthophosphoric acid for 20 seconds. Followed by rinsing with water for 20 seconds. EBS-Multi (3M Espe, Seefeld, Germany) adhesive system was applied in the dried cavity. The ceramic veneer was prepared in the same way as for cementing with the composite material Tetric. The dual composite cement Compolute was then applied in the cavity. The veneer was placed and pressed into the cavity with an ultrasound apparatus. Excess material was removed with an instrument and polymerized in the same way as the veneer cemented with Tetric.

The veneers were cut in the vestibulooral and mesiodistal direction. By cutting the veneers uniform fragments were obtained (1-4) whose type determined the place of direction (cervical, incisal, mesial, distal) (Figure 1). By cutting the veneers 96 identical fragments were obtained and analysed with a microscope. A stereomicroscope, OPTON SV 8 (Opton Feintechnik Gmbh - Oberkochen, Germany) with 160x magnification, was used to measure the marginal adaptation gap width.

Fitting of the veneer margin to the dental tissue was measured. Measurement of marginal adaptation was performed by a modified method of measuring vertical and horizontal margin discrepancy, according to Sorensen (16-18). Criteria for the quality of the adaptation were defined in the following way: 1. Ideal adaptation - complete fitting of the veneer margin to the prepared dental tissue, 2. Good adaptation - incomplete fitting of the veneer margin to the dental tissue, which is compensated by cementing material, and 3. Poor adaptation - incomplete fitting of the veneer margin to the prepared dental tissue, which cannot be compensated by cementing material.

Positive or negative adaptation was defined as quantified discrepancy from ideal adaptation in μm. In the case of positive adaptation the veneer was higher than the surface of the prepared cavity, while in the case of negative adaptation it was not completely fit on the cavity wall.

Results of measuring marginal adaptation of the veneers were statistically analysed by means of χ^2 - test, and results of measuring marginal gaps by analysis of variance (ANOVA).

Results

Results obtained by measuring adaptation of veneers cemented with Tetric to dental tissue showed ideal adaptation in 97.9% (Figure 2) and good adaptation in only 2.1% of the samples (Figure 3). Poor adaptation was not registered in the examined sample of veneers cemented with Tetric. Poor adaptation was also not registered in veneers cemented with Compolute. Ideal adaptation was determined in 95.8% of the samples, while good adaptation was found in 4.2% of the veneers. No statistically significant difference was determined by means of χ^2 - test, between the veneers cemented with Tetric and those cemented with Compolute (Table 1).

In the group of veneers cemented with Tetric, complete adaptation was determined in the vestibulooral direction in 39.6% of samples. Negative adaptation was established in 43.7% and positive in 16.7%. In the group of veneers cemented with Compolute complete adaptation was registered in 51.1% of samples. Negative adaptation was registered in 38.3%, while 10.6% showed positive adaptation. Statistical analysis did not reveal significant difference between the tested materials for cementing veneers in the vestibulooral direction (Table 2).

In the mesiodistal direction the quality of the adaptation of veneers cemented with Tetric was complete in 45.8% of veneers, and 39.6% were negative. Positive adaptation was determined in 14.6%. Complete adaptation in the group of veneers cemented with Compolute was determined in 52.1% of samples. In 45. 8% of the veneers adaptation was negative. Positive adaptation was recorded in 2.1% of the examined samples. Testing by χ^2 - test did not show statistically significant difference between the materials in the quality of adaptation of veneers in the mesiodistal direction (Table 3).

The results of this study show that complete or ideal adaptation of veneers on a prepared tooth was achieved by the Cerec method in more than 50% of the examined samples. Negative values in the vestibulooral direction indicate insufficient adaptation, which amounted on average to 493.80 μm, while positive values indicate excess material with regard to the contour of the prepared tooth and amounted on average to 388.96 μm. The mean value of seating/fitting in the mesiodistal direction amounted to 411.70 μm for negative discrepancy, i.e. 347.63 μm positive (Table 4).

Analysis of variance for the external margin in the vestibulooral direction did not show the existence of statistically significant differences in gap widths, either for Tetric (x=247.69 μm), or Compolute (x=257.62 μm). Neither was statistically significant difference determined for the tested material with regard to the place of measurement (cervical, incisal) (Table 5). In the mesiodistal direction the gap width in the samples cemented with Tetric was 156.56 μm (mesial x=138.40 μm, distal x=174.72 μm), while in the samples cemented with Compolute it was 169.08 μm (mesial x=183.2 μm, distal x=154.94 μm), which was not statistically significantly different for either the material or the place of measurement (Table 6).

Discussion

Comparison of the obtained values of marginal adaptation and gap width for Cerec 2 ceramic veneers with veneers fabricated by laboratory techniques, the high quality of Cerec 2 veneers is apparent. In their study of ceramic veneers fabricated by the technique of platinum foil, Sorensen and coworkers (18) determined marginal gap width in the cervical area of 248 μm and in the incisal area 146 μm. For the technique of refractive colour the value of the cervical marginal gap was 374 μm, while the incisal marginal gap was 304 μm. Tay and coworkers described marginal discrepancy of 400 μm (19).

Critical points during fabrication of veneers by Cerec technology are the method of preparation of labial surfaces (walls must be straight and rough, and veneer thickness must be at least 0.7 mm) and the direction and angle of the scanner towards the prepared surface and the place of the initial points when designing the veneer. Hahn and coworkers (20) investigated the method for preparation of the labial surface for Empress veneers and determined that veneer hardness can be achieved which is similar to that of the unprepared tooth if the preparation is restricted to the labial surface, without preparation of the incisal margin. In order to achieve the lowest value of marginal gap width and the best possible marginal adaptation, experience in the application of Cerec method is also important. It can be hypothesised that the values of marginal gap width for veneers fabricated in the mouths were slightly higher. For improved precision of preparation Brunton and coworkers (21) recommend the use of silicone index or grinder with marked values of the depth of the preparation.

Kihn and Barnes (22) studied the clinical success of ceramic veneers and determined their excellent marginal adaptation of 85% and colour stability of 100%, four years after cementation. Similar results were found by Peumans and coworkers (23). Excellent marginal adaptation of 93% was registered by Calamia (24), and Strassler and Weiner of 95% (25). Jordan and coworkers (26) determined excellent marginal adaptation in 83% of veneers. Christensen reported relatively low value of excellent marginal adaptation and Christensen of 65% cemented veneers (27). Dumfahrt and Schaffer reported similar values in an analysis of 191 ceramic veneers after 1-10 years. Most frequent failures were registered in cases of exposed dentine during preparation. Christgau (29) described excellent marginal adaptation of ceramic veneers even in cases where they were adjacent to composite fillings. In the majority of studies marginal gap width ranged from 100 to 400 μm, which were the values determined in this study, demonstrating the superiority of the Cerec system compared to other techniques of labial veneer fabrication.

The values of marginal gap width were lower when the material used was of higher viscosity for cementing veneers (e.g. Tetric). These results, although not statistically significant, confirm earlier reports. Peumans (23) reported that the material for cementing is a weak point in the fabrication and cementing of ceramic veneers, because of polymerization contraction between the cavity walls and the veneer, which can be as much as three times greater than the normal linear contraction of composite material. This can lead to greater polymerization contraction stress than in composite material. Peumans reported that another important factor is the dissolution of the resin matrix of the composite material in oral fluids, which can lead to the formation of marginal gap (23).

The fabrication of Cerec 2 veneers enables a high degree of individualisation of veneers, in view of the translucency and colour choice of the ceramic material, and also the cementing material with the addition of various opaque and composite colours (13). Individualisation can also be improved by registration of the shape and morphology of the labial surface of the treated teeth by the application of Korelacija II programme supplement, which enables achievement of a veneer which completely resembles the appearance of the labial surface prior to preparation of the dental tissue (8, 30).

The results obtained of marginal adaptation and gap width with Cerec 2 veneers, after cementing with two different micro-hybrid composite materials, show that both materials are suitable for clinical use.