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In vivo evaluation of marginal integrity of CEREC 2 inlays in two different machining options: Extrapolation and Correlation

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INTRODUCTION

Since the introduction of composite resin for the restoration of posterior teeth in the 1960's, great efforts have been made by manufacturers to improve the physical and mechanical properties of the materials and by clinicians to improve the restorative procedures. This has led to an improvement of the clinical performance of the later generations of posterior resin restorations. There are, however, still several material related problems, which have to be solved such as, fracture of material, marginal deficiencies, post-operative sensitivity and wear in the occlusal contact areas. The introduction of the CAD-CAM system and the reinforced restorative materials pertaining to the system may have provided the potential to solve some of these problems.

The CEREC system is the first commercially available CAD/CAM device in dentistry. It is capable of generating ceramic inlays, onlays, and veneers at chairside. The CEREC system has several advantages of producing restorations that are tooth-colored, utilizing the physical properties of porcelain, and requiring only one appointment.

The marginal integrity is an important factor for the long-term success of ceramic inlays. However, there were little studies of the quantitative occlusal margin analysis to detect early marginal deficiencies in vivo. And, the clinical measurement of occlusal marginal gap was needed to predict the longevity of ceramic restoration.

Therefore, the goals of this paper are (1) to design the measurement method, (2) to compare the occlusal marginal gap in two different options (*Extrapolation and Correlation) of CEREC, and (3) to evaluate that the method is working.

CASE 1 Extrapolation option (Indirect method)

A 26-year-old female was referred for exfoliation of restorations in teeth 36, 37, 46 and 47. Cavities were prepared and impression was taken. Green stone model was fabricated, and CEREC inlays were machined by

* The CEREC 2 unit offers three different options. : 1. Anatomically extrapolated ('Extrapolation'), 2. Correlated to a wax-up or functionally generated path ('Correlation') and 3. Bucco-orally flat ('Linear') as known from CEREC 1.

Extrapolation option. Then, Inlays were luted with translucent resin cement, Choice (Bisco. INC). After 1 week, occlusal clinical photos and x-rays were taken.

Photos were taken with digital camera, and the deformation and scale was fixed in the two-dimension individually. And resin cement rings were drew in black line utilizing 'Photoshop V 6.0'. From those images, areas of cement ring and cavity (Fig. 1), and perimeter of cavity were calculated by 'Sigmascan Image V 1.20'. Average marginal gap was acquired by dividing area of cement by length of cavity(Table 1).

CASE 2 Correlation 2 option (indirect method)

A 23-year-old female was referred for replacement of amalgam class 1 restorations in teeth 36, 37, 46 and 47 with ceramic inlays. Before removal of amalgam restorations, impression was taken, and all amalgam restorations were removed and impression was taken again. Models were made, and CEREC inlays were machined by Correlation 2 option. After five days, CEREC inlays were cemented with translucent resin cement named Choice. After 1 week, occlusal clinical photos (Fig. 2) were got in the same manner of case 1, marginal gap was evaluated(Table 2).

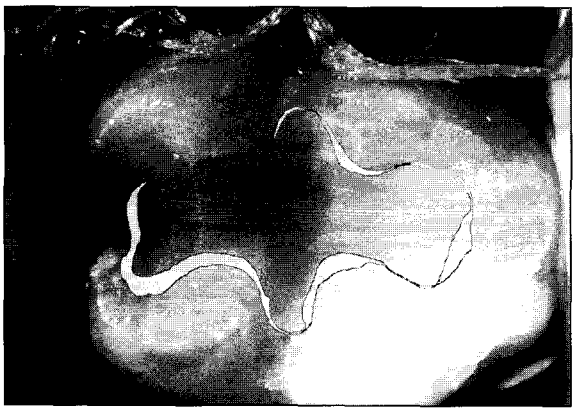

Fig 1. The resin cement area is filled with gray color in the CEREC restorations with Extraportion option.

Fig 2. In the same manner, the resin cement is painted in Correlation option.

Table 1. Extrapolation option

	36	37	46	47
AREA (mm)	3.07	0.95	2.78	2.19
PERIMETER(mm^2)	26.17	29.47	29.22	25.78
GAP WIDTH (mm)	0.1173	0.03224	0.0951	0.0849
Average Gap	0.08241			

Table 2. Correlation 2 option

	36	37	46	47
AREA (mm)	2.57	2.70	3.16	1.19
PERIMETER(mm^2)	28.86	26.40	28.02	24.09
GAP WIDTH (mm)	0.08905	0.1023	0.1128	0.04940
Average Gap	0.08837			

DISCUSSION

The average gap of extrapolation option is 82.41um and that of correlation is 88.37um. There is no significant difference in occlusal marginal gap between extrapolation and correlation option. However, in the aspects of consuming time and vertical discrepancy, extrapolation option was recommended by Schweiz Monatsschr.

The occlusal marginal gap of CEREC (about 85.4um) measured in vivo is consistent with the in vitro data (average marginal gaps for occlusal [59+/-35 microns] and interproximal [97+/-66 microns] margins, Sturdevant JR, Bayne SC, Heymann HO). So, this method is acceptable to evaluate the occlusal marginal gap clinically. So far, the method of clinical evaluation of ceramic inlay was X-ray taking. But, It is expected that this will be another method of evaluation ceramic inlay clinically.

The maximum gap is created in mesial margin mostly. The reason is that the CEREC ceramic block machining was finished at mesial margin, and manual ceramic block trimming was needed at mesial margin. It is the great reason for the mesial margin to be most fault site.

There may be some errors, when the deformation and scale are compensated manually. Also, it is possible that the drawing of outline is faulty. So, It is recommended that program, which will automate the above procedure, is coded.