

Marginal Accuracy of Ceromer Crowns and Effect of Relining on the Fitness

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Statement of Problem: Targis restorations provide good esthetic and clinical success; however, improving marginal accuracy requires further investigations.

Purpose: The aim of this was to study evaluate the effect of relining on the marginal accuracy of ceromer crowns.

Material and Methods: One ivorine maxillary central incisor was prepared for Targis crown. 10 acrylic models were duplicated from ivorine teeth. The specimens were randomly divided in to two groups. In the first group Targis crowns were made according to manufacturer's instructions. In the second group (relined group) after construction of Targis crown they were relined by Targis base. All of the specimens were luted with resin cement, embedded in epoxy resin and sectioned buccolingually and mesiodistally. Marginal and internal gap were assessed by image analysis system.

Results: The mean marginal opening in labial and lingual margin of Targis crowns were 37.14 ± 6.2 and 35.7 ± 6.2 and in relined group it was 72.1 ± 11 and $56 \pm 12 \mu\text{m}$ respectively. Statistical analysis showed significant difference between two groups ($P < 0.05$).

Conclusion: Considering limitations of this study, marginal opening and internal adaptation of the Targis crowns were in acceptable range for clinical application, however relining didn't improve the fitness of crowns.

Key words: Ceromer; Marginal gap; Marginal opening; Fixed Partial denture

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The desire for tooth colored and metal free restoration led to all ceramic restorative designs⁽¹⁻²⁾ but the brittleness of ceramic materials has limited their clinical applications.⁽²⁾ The recently introduced ceromer/fiber reinforced composite (FRC) system, which provides an attractive alternative to ceramic and resin materials, has enhanced the physical properties, improved esthetics and increased the durability.^(3,4) Wear value of ceromer is very close to natural teeth and the modulus of elasticity is quite similar to dentin. Ceromer

material a second generation indirect composites, contains sialanized micro hybrid inorganic filler embedded in a light-polymerizable organic matrix.^(5,6) Its mechanical properties have been improved compared to composite or ceramic, because of its high filler content and optimal polymerization process.⁽⁷⁾ One ceromer/ FRC is Targis/Vectris system developed by Ivoclar in 1996. It consists of approximately 80% inorganic particles that have an average size of $0.8 \mu\text{m}$.⁽⁸⁾ There are few reports on the long term results and the clinical

guidelines for success with the use of this system.^(4,5,6,7, 9-11)

The marginal fit of dental restorations is a vital factor to its long term success. Lack of adequate fit is potentially detrimental to the tooth and the supporting periodontal tissues.⁽¹²⁾

Great marginal discrepancies expose the luting material to the oral environment, leading to a more aggressive rate of cement dissolution, which is caused by oral fluids and chemo-mechanical factors. Therefore the cement seal becomes weak and permits percolation of bacteria.⁽¹³⁾ Even when insoluble cement has been used the lower wear resistance of cement compare to crown, compromise the longevity of tooth.⁽¹⁴⁾

Following ceromer polymerizations, it should have sufficient double bonds for adhering to resin cement.⁽⁵⁾ So it is logical to expect that these double bonds could adhere to another layer of ceromer following layering the crown and therefore can probably be effective in obtaining better marginal fit.

The purpose of this study was to measure marginal and internal gap of Targis crowns and compare it to relined crowns.

Materials and Methods

In this experimental study one ivory central incisor (AG₃- 3; Frasco, Tettnang, Germany) was prepared for complete coverage of ceromer crowns. The tooth was prepared according to the instructions for ceromer restorations using 1.5 mm incisal reduction, chamfer finish line with 1.2- 1.5 mm depth and 4-8° axial convergence angles.

The prepared tooth was duplicated with addition silicon impression material (President light, Colten AG, Altstätten, Switzerland) using a custom impression tray.

The impression was filled with self cured acrylic resin (Tempron, GC Co Tokyo, Japan). Ten specimens were prepared by this method. Each acrylic tooth was inserted in Typodont and duplicated by using addition silicon impression

material (President light, Colten. Schaan, Liechtenstein) and a custom impression tray with a 3 mm relief. The impressions were filled with type IV dental stone (Velmix. Kerr. Detroit Co). Die hardener (Surface hardener, Renfert GmbH, Hilzingen, Germany) and die separator (Picosep, Renfert GmbH) were applied on the stone dies. A silicon putty index of intact ivory tooth was used to standardize the ceromer crown dimensions.

Targis base was applied and cured for 20 seconds with Targis Quick (Ivoclar, Vivadent AG, Schaan, Liechtenstein). Targis dentine and incisal were incrementally built up. Each layer was polymerized by Targis quick (Ivoclar). The final restoration was cured and tempered in Targis power (Ivoclar) with program P₁ for 25 minutes. Final restoration was finished with tungsten carbide burs, rubber and wheel instruments (Polieriset; Ivoclar).

Ten fabricated crowns were randomly divided in to two groups.

All samples in group I were cemented and samples in group II were relined after applying one layer of modeling separator on the acrylic tooth. The restorations relined with Targis base and placed on to their corresponding acrylic tooth. After polymerization of relined crowns with Targis quick for 20 seconds, specimens were placed in Targis power for 25 minutes.

All of the finished crowns were luted to their corresponding acrylic tooth with dual curing resin cement (Variolink II, Ivoclar). During the cementation procedure, the crowns were placed under a constant load of 10 N for 10 minutes and cured for 40 seconds from buccal and lingual aspect of tooth. After removing the excess cement and cleaning the restorations margin, samples were stored in distilled water for 24 hours. Then fabricated crowns were embedded in epoxy resin (Deiterman- R, Germany).

Each crown was sectioned with a diamond wafering saw in mid-buccolingual and mid-mesiodistal plan. The sectioned specimens were

polished with 240, 320, 400, 600 and 1000 grit silicon carbide sand papers (Carbimat paper, Buehler Ltd) sequentially. In order to measure marginal and internal gap, the polished specimens were examined with Omnimet image analysis system (Buehler USA) at X65 magnifications. The measurement points for each specimen were made at incisal, mid labial, midlingual, lingual, labial margins, mid mesial, middistal of distal and mesial and distal margins. A variety of possible choices for measurement of marginal errors has been documented and defined.⁽¹⁵⁾ The marginal gap was chosen for this study.

Student t test ($\alpha=0.05$) was used to compare marginal gap and internal gap between two groups.

Results

The mean value of marginal and internal measurement are summarized in table I and II. Statistically significant difference was found between each measurement point on the relined and crown (unrelined) groups ($P<0.05$), except proximal margins which no significant difference was found ($P=0.65$).

Discussion

Along with several factors, marginal accuracy is an importation criterion of quality of fixed prosthodontics. There are few reports about marginal adaptation of ceromer crowns. In the most of these studies marginal fit has measured by semi-quantitative analysis.^(15,16) In this method marginal adaptation is categorized under criterion as perfect margin and the width of luting cement has not been considered.

Leinfelder et al found interfacial gap shouldn't exceed 100 μ m. Margins greater than this commonly result in extensive wear of luting cement.⁽¹²⁾ In this study the average of marginal gap in Targis crowns was 37 μ m in midbuccal and 35 μ m in midlingual. Cho et al reported the marginal gap in Targis bridges with 6° convergence was 76 μ m.⁽¹⁷⁾ Behr found the

average width of luting composite in adhesive fixed partial denture was 84 μ m for the box-shaped prepared bridges and 113 μ m for the tub-shaped bridges.⁽¹⁵⁾

This study showed lower amount of marginal gap. It's probably because in those articles, bridges were made with Targis and Vectris but in this study Targis crowns were made without fiber. On the other hand greater marginal gap could be expected in bridges rather than in crowns because the ceromer is bulkier in bridge, therefore amount of polymerization shrinkage will be greater. In relined group, the thickest part of cement was 94 μ m in incisal and the thinnest one was 43.75 μ m in midbuccal. In unrelined group these values were 65.4 and 23 μ m respectively. This study showed significant difference between 2 groups. This may be due to excessive hydraulic pressure of Targis base in relined group and incomplete seating of Targis crowns during relining the crowns.

Another important consideration in fitness measurement is the standard deviation associated with mean values. The midrange of standard deviations reported in the literature is approximately 15 to 25 μ m. The standard deviation reported in this study was within this range.⁽¹⁸⁾

Table I: Mean and standard deviation of marginal and internal gap in two groups (Bucolingual section)

Points	Relined	Targis
Incisal	84 $\pm$ 6.8	64.3 $\pm$ 9.3
Mid buccal	53.8 $\pm$ 5.8	33.62 $\pm$ 6.1
Mid lingual	69 $\pm$ 2.9	33 $\pm$ 3
Mar. lingual	56 $\pm$ 12	35 $\pm$ 6
Mar. buccal	72 $\pm$ 11.1	37.4 $\pm$ 6.2

Table II: Mean and standard deviation of gap in two groups (Mesiodistal section)

Points	Relined	Targis
Incisal	70.3 $\pm$ 22	30 $\pm$ 7
Mid proximal	45 $\pm$ 10	11 $\pm$ 3.3
Margin proximal	50 $\pm$ 12	54 $\pm$ 11.2

The absolute marginal opening (AMO) is reported in most studies of crown fitness using marginal opening as a generic term. The AMO was not used in this study because it was the consensus of the investigators the AMO would vary significantly, depending on the overextension or underextension of crowns. The marginal gap would be unaffected by overextension or under extension of the crowns.⁽¹⁸⁾ One limitation of this study was that the crowns were not subjected to artificial aging process, thermocycling and mechanical loading. Behr et al reported that artificial aging has a significant effect on reducing marginal

integrity.⁽¹⁵⁾ However Bechindt et al reported no significant influence of aging on the marginal fit in chewing simulator.⁽¹³⁾

It can be advised that in future studies clinically important aspects, such as static chemical and cyclic mechanical fatigue should be considered.

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