Fiber Reinforced Inlay Adhesion Bridge

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FRC/ceromer system provides the clinician with a durable, flexible, and esthetic alternative to conventional porcelain fused to metal crowns. FRC is the matrix which is silica-coated and embedded in a resin matrix. The ceromer material which is a second generation indirect composite resin contains silanized, microhybrid inorganic fillers embedded in a light-curing organic matrix. FRC/ceromer restoration has a several advantages: better shock absorption, less wear of occluding teeth, translucency, color stability, bonding ability to dental hard tissues, and resiliency. It has versatility of use including inlay, onlay, single crown, and esthetic veneers. With adhesive technique, it can be used for single tooth replacement in forms of inlay adhesion bridge. In single tooth missing case, conventional PFM bridge has been used for esthetic restoration. However, this restoration has several disadvantages such as high cost, potential framework distortion during fabrication, and difficulty in repairing fractures. Inlay adhesion bridge with FRC/ceromer would be a good alternative treatment plan. This article describes a cases restored with Targis/Vectris inlay adhesion bridge. Tooth preparation guide, fabrication procedure, and cementation procedure of this system will be dealt. The strength/weakness of this restoration will be mentioned, also. If it has been used appropriately in carefully selected case, it can satisfy not only dentist' s demand of sparing dental hard tissue but also patient' s desire of seeking a esthetic restorations with a natural appearance.

Fiber-reinforced composite (FRC) formulations were developed to serve as structural components for various dental appliances such as splints and prosthodontic framework[1-9]. This material provides the clinician with a durable, flexible, and esthetic alternative to conventional porcelain fused to metal crowns. The combination of good FRC strength, handling, and esthetics allowed for the conception and development of a full coverage fixed prosthesis with an FRC substructure covered by a wear resistant ceromer. A new material can be used in conjunction with FRC systems, so-called 'ceromer' (polymer glass ceramic) materials have become available for fabrication of inlays, onlays, crowns and veneers[10-12]. The ceromer material which is a second generation indirect composite resin contains silanized, microhybrid inorganic fillers embedded in a light-curing organic matrix[13,14]. Due to high filler content, mechanical properties of the ceromer has considerably been improved. Moreover, physical properties have been improved with the use of light-heat-gas (N_2) which induces more complete polymerization and less poly-

merization shrinkage than that of the composite material. The commercial ceromers had variable filler contents and size (Table 1).

While ceramic as an esthetic restorative material is so brittle that it is easy to fracture and wears occluding teeth, ceromer has better shock absorption ability and does not cause attrition of teeth. It has translucency and improved color stability over conventional composite resins. These materials can be bonded to dentin and enamel for excellent retention and seal. The thermal expansion coefficient and the moduli of elasticity of the ceromer are quite similar to that of dentin[17]. When subjected to intraoral stress, the material exhibits a deformation capacity that is similar to that of a natural tooth, which reduces the fracture-inducing stress between restorations and dentition.

The indications for FRC/ceromer encompass a broad spectrum of single-tooth and FPD restorations. This systems were most frequently used for making inlay, onlay, single crown. Krejci recommended this treatment for three unit FPDs in anterior and posterior regions[10]. With adhesive technique, it could be used for single tooth replacement in forms of inlay adhesion bridge. In case of recovering a single tooth, following three options could be considered: implant, conventional metal-ceramic fixed partial dentures and adhesion bridge. Implant treatment would be the best treatment choice except it's cost. Conventional metal ceramic fixed partial denture has several clinical problems such as opaque appearance, more wear of occluding teeth and fracture possibility. Moreover, it requires invasive tooth preparation and threaten pulp vitality. In this case, inlay adhesion bridge with FRC/ceromer would be a alternative treatment plan. It might be extremely sparing technique of dental hard tissue because of their excellent bonding and it's dentin-like physical properties. It is significantly cost-effective and has tooth-like translucency as a result of being metal-free. Moreover, it may be used in patients who are sensitive to metals since no metallic framework is required.

The purpose of this article is to describe a procedure to construct a three unit inlay adhesion bridge for single tooth replacement. When used to young patient of little masticatory force appropriately, demands of the patient can be achieved.

Table 1. Comparison of commercial ceromers[10,14-16].

Brand name	Monomer	Filler content (wt%)	Filler	Filler size	Curing (time)	Manufacturer
ArtGlass	UDMA Methacrylic ester	70	*Silicone dioxide* Barium alumina silica glass	0.7μm	Light (10min)	Kulzer, Germany
Sculpture	PCDMA TEGDMA Ethoxylate A DMA	79	Barium borosilicate glass Hydrophobic amorphous silica	0.6μm	Light & Heat (25min)	Ivoclar Richitenschetein
Targis	Bis-GMA Decandiol UDMA	75-85	Barium-aluminum silicon glass Mixed oxide Silicon dioxide	1mm 200nm 40nm	Light & Heat under N_2 (15min)	Generic/pentron, USA

PROCEDURE

A 26-year-old female patient presented with missing mandibular first molar (Fig. 1). The periodontal condition was healthy with adequate attachment. The occlusal relationship was Class I with the group function occlusion. The patient wanted the non-invasive esthetic treatment. Targis/Vectris inlay adhesion bridge were chosen for the following reasons: more looking like natural teeth, having a adequate space for the FRC, superior long-term seal and retention.

Clinical Procedure (1st visit)

After shade selection, tooth preparation was done. If old restorative material or superficial caries existed, removal of these structure precedes tooth preparation. Several retainer preparation methods like a proximal box, tub, slot are suggested. There were no reports on the appropriate tooth preparation method in this case. We adopted the proximal box and occlusal dovetail for more retention by Freilich (Fig. 2)[18]. From the interview with Penchas, Neuman reported that the box of the inlay must be at least 2mm in width, depth, and height for fiber space[19]. However, Krejci recommended more invasive preparation more than proximal slot must be needed in the canine restoration, especially[10]. Desensitization treatment might be well to eliminate postoperative pain

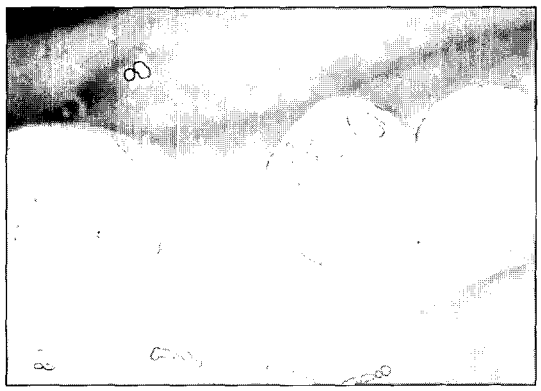


Fig. 1. Missing state of right first molar.

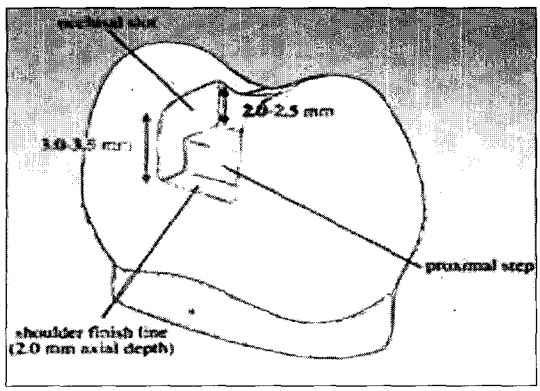


Fig. 2. Tooth preparation method recommended by Freilich.

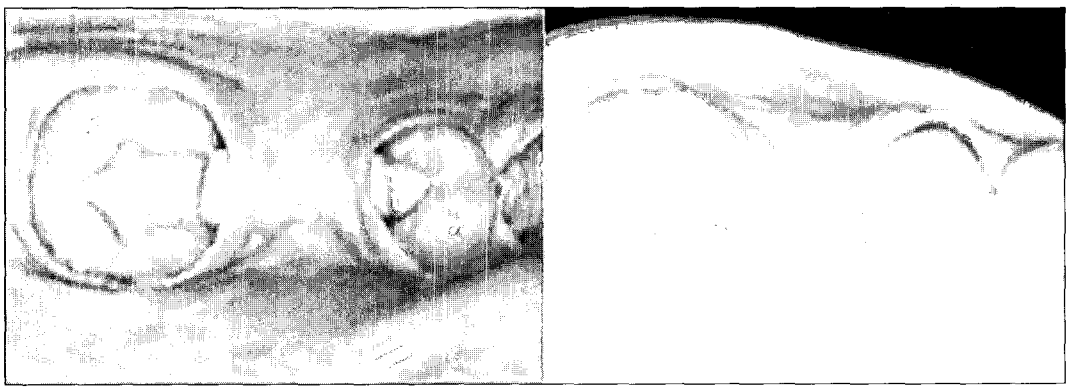


Fig. 3. Two step silicone impression was taken and resultant cast.

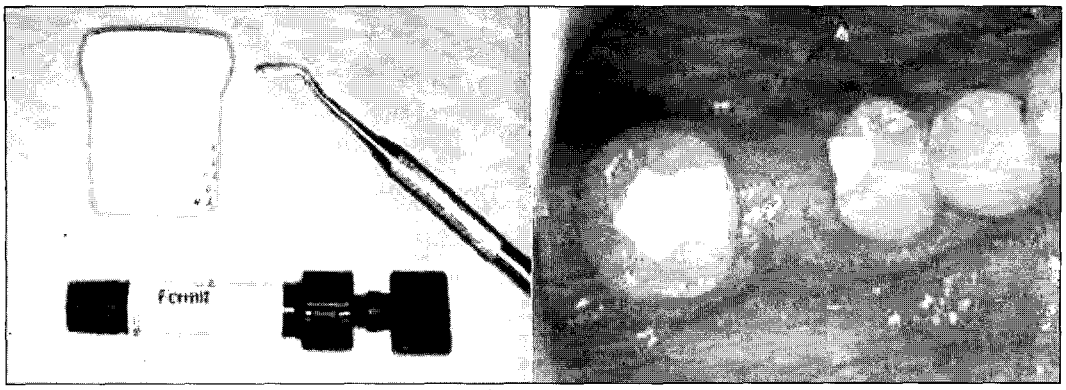
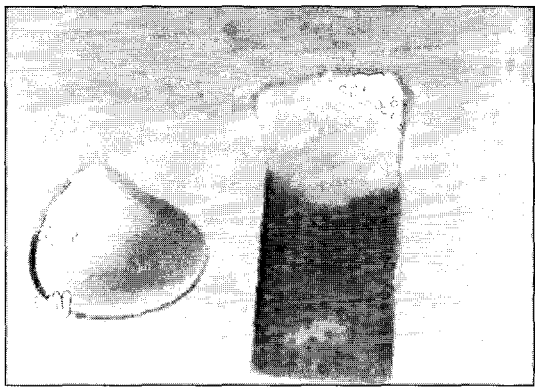
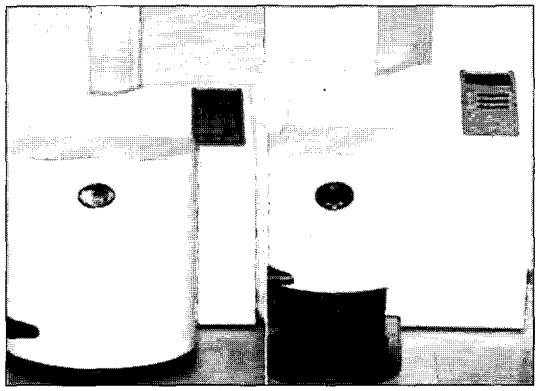


Fig. 4. Filled Caviton into the cavity for preventing sensitivity.



5-a



5-b

Fig. 5-a. Three types Vectris. Left is 'single', middle 'frame', and right 'pontic'
Fig. 5-b. Targis and Vectris curing unit.

and bacterial penetration during the temporary restoration period. If there was unsupported enamel, light curing compomer or other treatment would be needed. The final steps are rounding the carvoaxial surface and finishing the cavity margins.

Impression taking were done according to the existing guidelines for conventional fixed restorations (Fig. 3). For the temporary restoration, light curing elastic resin, eg, Fermit, can be used. With this temporization, however, retention failure frequently occurred. Therefore, we used the Caviton for preventing sensitivity (Fig. 4).

Laboratory Step

For constructing the substructure, Vectris 'pontic' were used. Vectris, the glass fiber-reinforced light-curing material, is available in a universal shade and in 3 forms (Fig. 5). All fibers are silica-coated and embedded in a resin matrix (prepreg). They can be distinguished by the type of fiber orientation. According to the manufacturer, the prepregs with fiber orientation aligned at 45° are called 'single'; those at 90° a 'frame'; and the prepregs with parallel fiber orientation are called 'pontic'.

A wax lump filled the proximal box and occlusal dovetail was placed between the abutments (Fig.

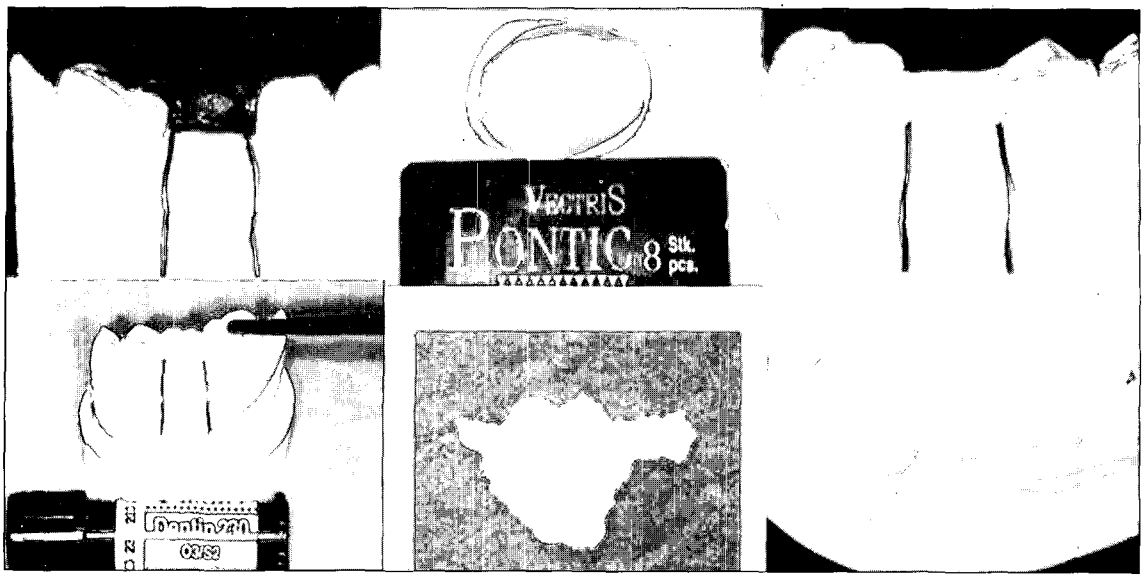


Fig. 6. Fabrication procedure. Wax lump and silicone key was made. For pontic base, Targis dentin were previously added and tub shape 'pontic' was made. Then, Targis base, dentin, and incisal was build up.

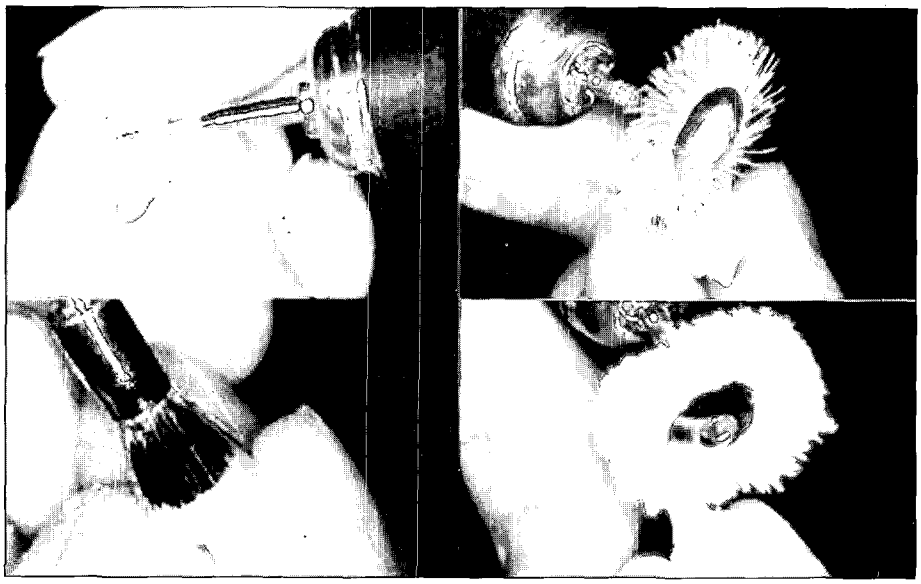


Fig. 7. Step by step polishing with diamond bur, silicone wheel, Robinson brush, and polishing buff, successively.

6). Frequently, Vectris on the edentulous site showed rough pontic base. So, we added Targis Dentin on the edentulous area previously. Then, we made the silicone putty key leaving the occlusal area open. Vectris 'pontic' were fitted into the cavity. The 'pontic' was cured in Vectris

Table 2. Conventional finishing methods for several ceromers.

Materials	Instruments	Manufacturer	
	Art-Glass tool kit		
ArtGlass	Polisher (Prepol)	5000 rpm / 120 s	
	Polisher (Mepol)	5000 rpm / 60 s	Kulzer, Wehrheim, Germany
	Polisher (Hipol)	5000 rpm / 120 s	
	Big silicone point (BL-R3)	5000 rpm / 120 s	Shofu, Düseldorf, Germany
	Robinson brush (brown)	5000 rpm / 120 s	Renfert, Germany
Targis	Silicone wheels, white		Ash / Dentsply, York, USA
	Linen brush and Polishing paste green		Ivoclar, Schaan, Liechtenstein
	Linen brush and Polishing paste blue		Ditto
	Big silicone point (BL-R3)	5000 rpm / 120 s	Shofu, Düseldorf, Germany
Sculpture	Robinson brush (brown)	5000 rpm / 120 s	Renfert, Germany
	Polishing buffers		
	Glazing under vacuum	225°F / 15 min	Sculpture / FibreKor curing unit

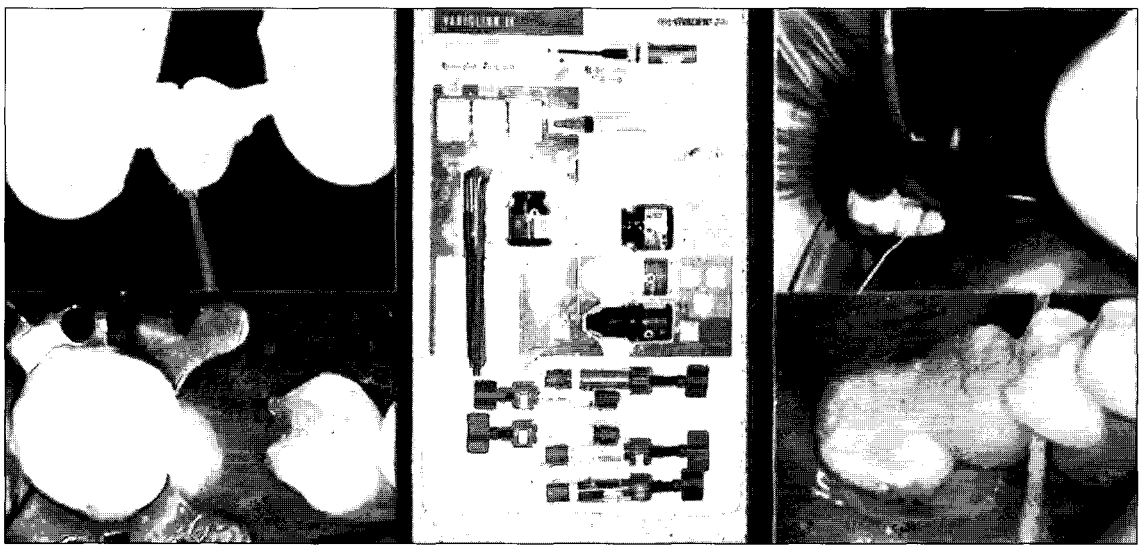


Fig. 8. Cementing procedure. VARIOLINK II was used. Vaseline was coated under the pontic base for easy removal of excess cement. Tooth and the restoration should be treated according to the manufacturer' s instruction. After 10 second initial curing, excess cement must be removed.

VS1 curing unit for 9 minutes. Removing the 'pontic' was very difficult work because of it's hard physical properties. So, using the duplicate die would be recommended. Cured substructure were ground up to 1mm below from cavity margin and then sandblasted, silane treated, and coated with Heliobond. The substructure were built up all around with layered Targis. Each layer was polymerized for 10 seconds in the Targis Power unit. The completely built-up inlay

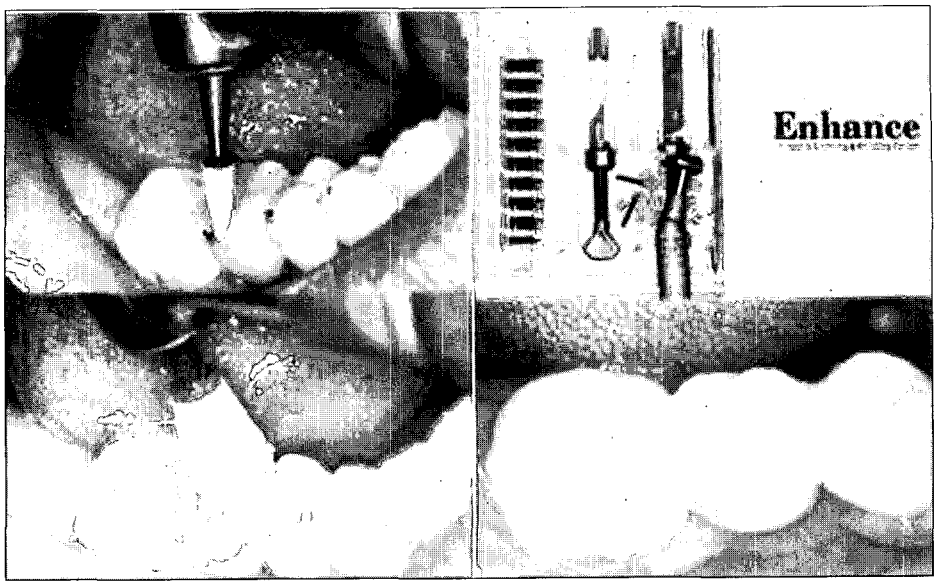


Fig. 9. After cementation, occlusal correction and final finishing was done with resin finishing paste (Enhance).

adhesion bridge was sealed with heat and light in the curing unit.

Each ceromer had to be finished with different methods. Several recommended finishing methods were presented in Table II. We used diamond burs for shaping and, silicone wheel, Robinson brush, polishing buffers with polishing paste (Fig. 7).

Clinical Procedure (2nd visit)

After removal of the temporary restoration, the cavity were cleaned with fluoride-free pumice. And then, restoration was tried in and corrected with Fit-Check. Only, internal adaptation and proximal contacts were adjusted and occlusal correction were delayed to post cementation. The usual luting procedure was then followed (Fig. 8). It was recommended that final cementation procedure must be done under the rubber dam to protect it from saliva and moisture contamination. There are two cementation methods; 'selective bonding' and 'total bonding'. Selective bonding were used in cementing the inlay, onlay and total bonding in the single crown, fixed partial denture. We used selective bonding for this case.

After sandblasting with 50μm aluminum oxide, the restoration was silanized, and treated with bonding resin. While, enamel and dentin were etched with 37% phosphoric acid according to the manufacturer's instruction. Then, conditioning of dentin and treating with bonding agent were done. We cemented restoration with dual setting composite Variolink (Vivadent). High viscosity cement might used for inlay, while low viscosity for full crown. Excess material was removed with a cotton pellet. After brief ten-second curing, cured excess were removed with explorer. Polymerization procedure should be done completely with light from the each side for 60 seconds, respectively. Occlusion was checked after removal of the rubber dam with finishing diamonds(Fig. 9).

DISCUSSION

Fabrication of fixed partial dentures without metal substructures offers the optical advantage of more natural light dynamics and decrease the potential biologic incompatibility. Clinical observations over 4-year periods have shown that this restorations had equal longevity to ceramic

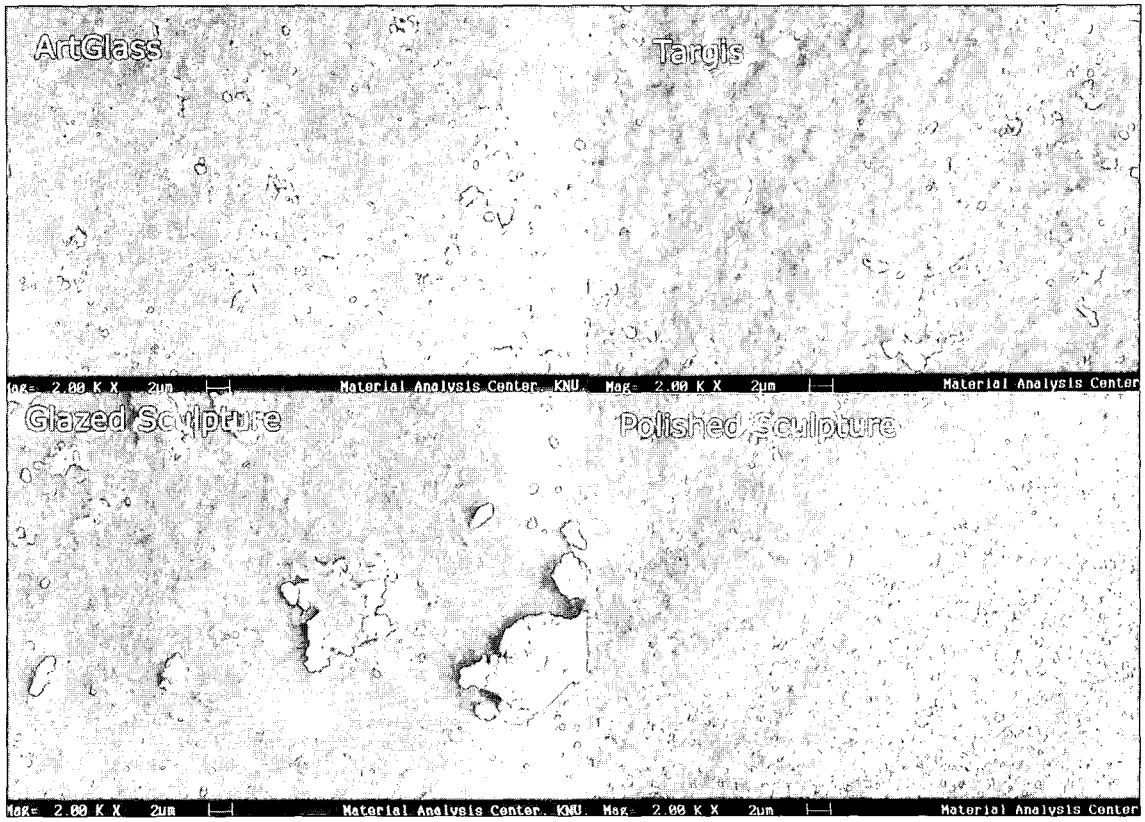


Fig. 10. SEM view showes finished surface state. Filler size were various by the type of ceromer.

restorations[20]. The upper part of the restoration, ceromers are more resilient than brittle ceramic, which makes them less likely to fracture. In clinical environment, however, inappropriate use of adjusting instruments leave deep scratches on the surface. It means that ceromer had lower surface hardness and abrasion resistance. In our laboratory study for long term use in simulatory mouth, all of the ceromers showed some changes in surface texture and gloss. Therefore, soft tooth brush and low abrasive dentifrice is recommended. In periodontal treatment, careful instrumentation will be needed as well.

In SEM view, we could observe the filler size and it's distribution (Fig. 10). Targis showed that larger filler were blended with smaller filler. ArtGlass presented the smallest size particle of three ceromer, while surface glaze of Sculpture showed partly intermingled state. This might be the possible reason why the surface texture were different each other.

Several finishing methods could be used. All of the ceromer materials excluding Sculpture is finished with various polishing instrument. Just after finishing, glazed Sculpture showed high luster and esthetic appearance. However, it demonstrated fallen out coatings and craze within glaze. Therefore, we recommend the finishing methods for Sculpture polishing with same instruments with Targis.

There were few reports on the long term study of this restoration. Krejci reported that SEM revealed excellent margin after 1 year[21]. In other reports, examination after an average of

55.3 months revealed a 100% retention rate without fracture[10]. Further studies to report the long term results are needed.

Despite the advantages of this technique, the resultant prosthesis would be more susceptible to occlusal wear. Moreover, brittle FRC showed crack in the joint when it was tried to the preparation with undercut. So, undercut in the cavity must be removed and all line angle should be rounded.

CONCLUSION

This article describes a procedure of fabricating a Targis/Vectris inlay adhesion bridge that spares tooth structure and chair time. If this restorations are placed properly, it will result in a functional and esthetically pleasing restoration.

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