A fundamental bonding technique for silver-palladium-copper-gold alloy framework to be veneered with indirect composite material

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Indirect composite material and metallic framework are chemo-mechanically bonded with adhesive systems. This technical report describes a fundamental bonding technique for silver-palladium-copper-gold alloy. The procedure reported here is applicable in fabrication of both single restorations and fixed dental prostheses.

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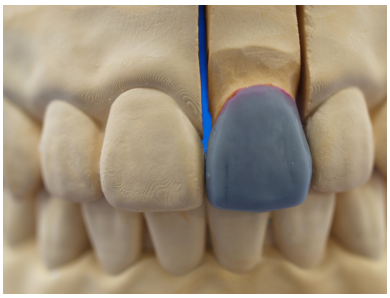
Key Words: adhesive, bonding, primer, silver-palladium-copper-gold alloy

Introduction

Restorations and fixed dental prostheses (FDP) made of silver-palladium-copper-gold (Ag-Pd-Cu-Au) alloy are covered with Japanese social insurance schemes as one of the dental treatment options. Specifically, composite resin veneered castings made of Ag-Pd-Cu-Au alloy are applicable for anterior restorations, abutments and pontics of FDPs as one of the insurance-covered programs. It is critical for restorations that bonding between indirect composite resin and metallic material is consistent and durable. A number of primers for bonding casting alloys have been introduced into dental laboratory procedure.[1-4] Although results of bond strength testing are extensively reported, limited information is available about proper bonding technique in fabrication of composite resin veneered restorations.[1,2] This technical article describes a fundamental bonding technique of Ag-Pd-Cu-Au alloy to be veneered with tooth-colored indirect composite resin.

Technical Procedure

The following procedure shows a fundamental technique for fabrication of a maxillary single restoration to be used for education in dental technology for restorations and fixed dental prostheses. The laboratory procedures consisted of the following steps.



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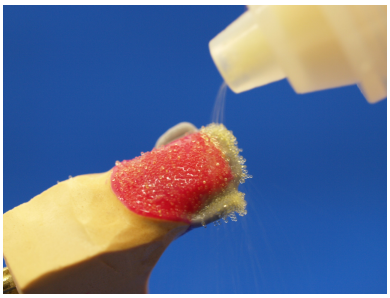

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1. Prepare a wax pattern of the restoration on the stone die (Fig. 1).
2. Cut back the facial surface of the wax pattern with a carving instrument (Fig. 2).
3. Apply adhesive and sprinkle retentive beads 150-200 μm in diameter (Retention Beads II ss, GC Corp., Tokyo, Japan) (Figs. 2, 3).

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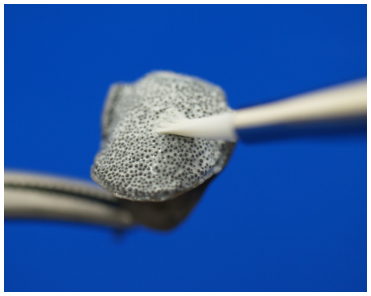

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4. Invest the wax pattern into a cristobalite mold material. Cast Ag-Pd-Cu-Au alloy (Castwell M.C.12, GC Corp.) into the mold with a centrifugal casting apparatus. Grind with rotary cutting instruments the peripheral area of the cut-back surface to remove retentive beads and to flatten the marginal veneering area. Abrade the cut-back surface with 50-70 μm alumina (Hi-Aluminas, Shofu Inc., Kyoto, Japan) by means of an airborne particle abrader (Jet Blast II, J. Morita Corp., Suita, Japan), to increase the bonding area and mechanically clean the surface (Fig. 4).
5. Apply a single liquid priming agent (Alloy Primer, Kuraray Noritake Dental Inc., Tokyo, Japan) containing both a thione monomer (6-(4-vinylbenzyl-*n*-propyl)amino 1,3,5-triazine 2,4-dithione, VTD) and a phosphate monomer (10-methacryloyloxydecyl dihydrogen phosphate, MDP) to the alumina-blasted surface (Fig. 5, Table 1).
6. Apply a single liquid bonding agent (Cesead N Opaque Primer, Kuraray Noritake, Dental Inc.) for bonding between the framework and the opaque resin. Paint thin layers of opaque material, and expose the each layer to light from a laboratory polymerizing apparatus (Fig. 6). Characterize the opaque resin surface with the appropriate shade of staining material.

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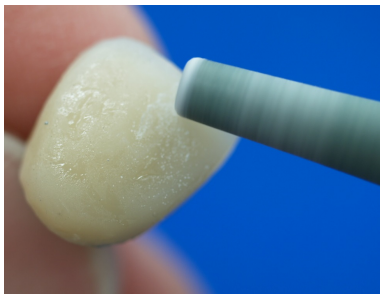

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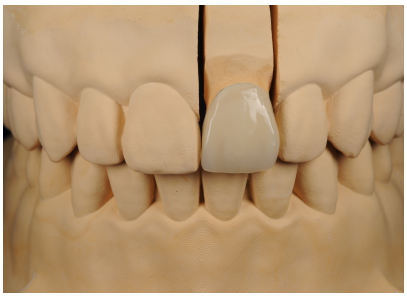

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7. Place the dentin portion of the composite material (Cesead N) with a laboratory instrument, and pre-polymerize the resin material. Insert hair-lines and/or other characteristics again using the staining materials before application of the incisal colored material. Add an enamel portion material (Cesead N) to the incisal edges to reproduce a natural tooth-color appearance (Fig. 7).
8. Light-polymerize the veneered materials in the laboratory light-polymerization. Grind and polish the surface with rotary instruments (Smooth Cut, GC Corp.; Seiko Wheel, Seikosha, Kurume, Japan; and Sharp Mini, Ohki Chemical, Hiroshima, Japan) (Fig. 8).
9. Use a diamond paste (Dia Glaze, Yeti Dental-Shirokusu, Osaka, Japan) to achieve a microscopically smooth surface (Fig. 9).

Table 1. Adhesive functional monomers and primers applicable for bonding composite resin and casting alloys

Compound (Functional group)	Formula	Monomer	Primer trade name (Manufacturer)
For noble metal alloys (Ag-Pd-Cu-Au alloy, Gold alloy)			
Thione (Thioxo group)	=S	MTU-6	Metaltite (Tokuyama Dental)
Thione (Thioxo group)	=S	VTD	Prime Art Opaque Primer (Sun Medical)
Thione (Thioxo group)	=S	VTD	Alloy Primer (Kuraray Noritake)
Disulfide (Disulfide group)	-S-S-	10-MDDT	M. L. Primer (Shofu)
For base metal alloy (Co-Cr alloy, Ti-6Al-7Nb alloy, Titanium)			
Phosphate (Phosphoryl group)	$-OP(=O)(OH)_2$	MDP	Cesead N Opaque Primer (Kuraray Noritake)
Phosphate (Phosphoryl group)	$-OP(=O)(OH)_2$	MDP	Alloy Primer (Kuraray Noritake)
Phosphonic acid (Phosphonyl group)	$-P(=O)(OH)_2$	6-MHPA	M. L. Primer (Shofu)

Discussion

This technical article discusses chemo-mechanical retentive system between composite resin and Ag-Pd-Cu-Au alloy. Mechanical retention is usually achieved through the use of retentive beads. As shown in Fig. 4, retentive beads are removed from the cast metal framework along the peripheral area of the cut-back surface. Although alumina particles were thereafter blasted, application of adhesive primer is recommended for enhancing marginal integrity of veneer-metal interface.

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