A fundamental soldering technique for type 4 gold alloy framework to be veneered with tooth-colored composite material

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Denture retainers and pontics made of gold alloy are connected with one-piece casting, soldering, or welding. This technical report describes a fundamental soldering technique for type 4 gold alloy. The procedure reported here is applicable to frameworks to be veneered with composite facing materials. Both the advantages and disadvantages of the procedure are discussed. **(Asian Pac J Dent 2013; 13: 41-45.)**
Key Words: connector, gold alloy, joint, solder

Introduction

Separately cast structures made of dental alloys are connected by means of soldering, welding, and/or cast-bonding. Microstructure,[1-3] laboratory procedure,[4] and mechanical characteristics,[5] of soldered gold alloys have been evaluated. Also, a number of papers concerning laser-welding of gold alloys are currently available.[8-11]

It is required for undergraduate dental students or students belonging to dental professional training colleges to learn about soldering techniques of gold alloys, since gold-based casting alloys are extensively used in clinics and dental laboratories. Soldering can be applied both before and after porcelain firing according to the structures and locations of connectors. Soldering of composite resin veneered prostheses, however, must be completed before application of facing materials to avoid pyro-degradation of resin matrix components. This technical article describes a fundamental soldering technique of a type 4 gold alloy to be used for a framework of composite resin veneered fixed denture.

Technical Procedure

The following procedure shows a technique for soldering type 4 gold alloy (70 Au, 2 Pt, 3 Pd, 8 Ag, 16 Cu, wt%; Casting Gold M.C. Type IV, GC Corp., Tokyo, Japan) with a representative soldering system.

Fig. 1.

Fig. 2.

Fig. 3.

1. Place two pieces of the fixed partial denture (FPD) to the abutment teeth (Fig. 1).
2. Stabilize the pontic with utility wax (Fig. 2).
3. Prepare a custom tray for impression with paraffin wax (Fig. 3).

Fig. 4.

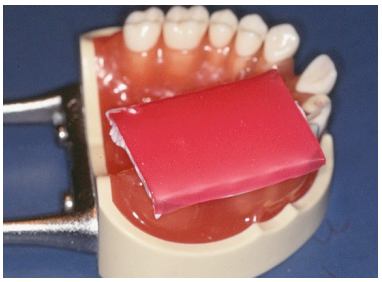

Fig. 5.

Fig. 6.

Fig. 7.

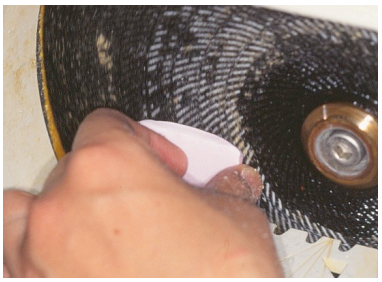

Fig. 8.

Fig. 9.

Fig. 10.

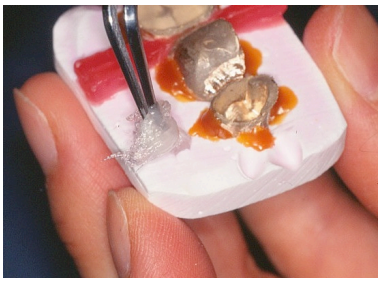

Fig. 11.

Fig. 12.

4. Pour an impression material (Impression Plaster, Maruishi Gypsum Co., Ltd., Osaka, Japan) to the custom tray (Fig. 4).
5. Make an impression of occlusal surfaces of the castings to be soldered (Fig. 5).
6. Confirm the proper position of the two pieces within the set plaster material (Fig. 6).
7. Occlusal surfaces of the castings reflected in the set impression material (Fig. 7).
8. Trim the plaster block with a model trimmer and running water coolant (Fig. 8).
9. Trimmed plaster block and castings (Fig. 9).
10. Fix the castings to the plaster block with sticky wax, and place a pair of cone or pyramid structure crossing the connector (Fig. 10).
11. Apply petroleum jelly to the plaster surface as a separating medium between the plaster core and refractory investment material (Fig. 11).
12. Place a piece of utility wax surrounding the plaster block (Fig. 12).

Fig. 13.

Fig. 14.

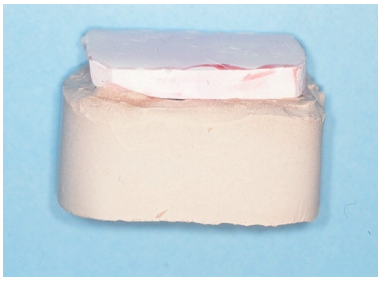

Fig. 15.

Fig. 16.

Fig. 17.

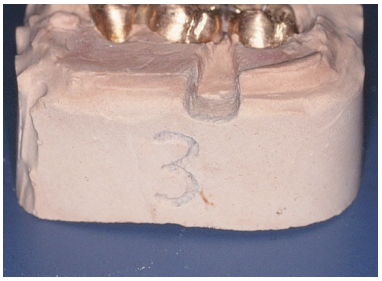

Fig. 18.

Fig. 19.

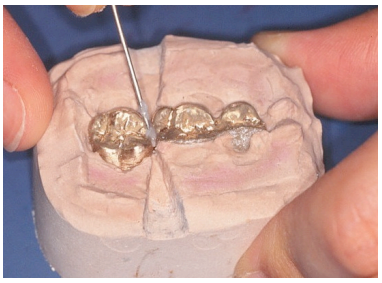

Fig. 20.

Fig. 21.

13. Form a box for a container of refractory investment material with paraffin wax (Fig. 13).
14. Pour slurry of a refractory investment material (Soldering Investment or Soldervest Quick, GC Corp.) into the box under vibration (Fig. 14).
15. Remove the box after setting the investment material (Fig. 15).
16. Separate the plaster block and the investment material under boiling water (Fig. 16).
17. The invested two pieces at pre-soldering stage (Fig. 17).
18. Place fire-way prior to the soldering procedure (Fig. 18).
19. Air-dry the investment material as completely as possible to avoid fracture during the soldering process (Fig. 19).
20. Apply flux material to the alloy surfaces to be connected (Fig. 20).
21. Use a small blowpipe for soldering the connector (Fig. 21).

Fig. 22.

Fig. 23.

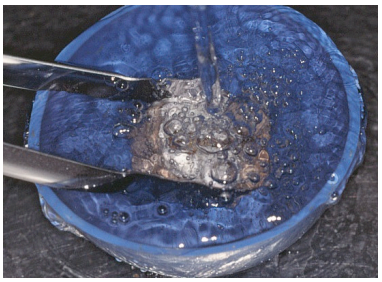

Fig. 24.

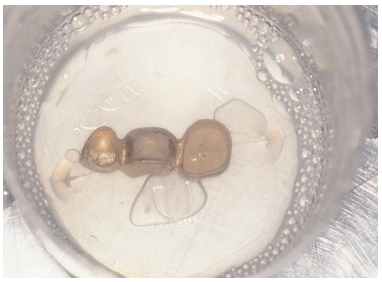

Fig. 25.

Fig. 26.

Fig. 27.

22. Place a piece of soldering material (Gold Solder or K.16. Solder, GC Corp.) after primary heating with a blowpipe (Fig. 22).
23. Apply reducing flame from the blowpipe across the investment material groove (Fig. 23).
24. After completion of soldering, remove the investment material with running water (Fig. 24).
25. Ultrasonically clean the soldered casting with 40-50% hydrochloric acid (HCl) aqueous solution for a few minutes or more (Fig. 25)
26. Soldered connector (Fig. 26).
27. Completed FPD veneered with a highly loaded composite material (Fig. 27).[12]

Discussion

A fundamental soldering technique of type 4 gold alloy was described mainly for educational purposes. The advantages of this soldering technique are as follows; 1) Technique is simple and understandable step by step, 2) The soldering system and materials are not expensive, and 3) Adaptation of soldered structures to abutment teeth is excellent. However, the following disadvantages are indicated; 1) It is difficult to fix accurately the cantilever structures intraorally, 2) Boxing and investing processes are time-consuming, and 3) Composition of casting alloy and solder is not identical.

Before impression making, the surface to be soldered should be cut with a rotary instrument. Appropriate distance between the retainer and the pontic ranges from 0.05 mm to 0.15 mm (Fig. 1). Care must be taken to stabilize a cantilever structure like a pontic shown in Fig. 2. This case used utility wax surrounding the pontic. An impression of occlusal plane can be made either extra- or intra-orally with slurry of an impression plaster. The authors recommend intraoral impression procedure to facilitate the proper placement of the connected components (Fig. 5). Selection of investment material is a critical issue for the dimensional accuracy of soldered castings. According to the manufacturer, properties of the Soldervest Quick material (W/P=0.22; GC Corp.), a succeeding material to the Soldering Investment, are as follows: setting time, 3.3 minutes; setting expansion,

0.18%, thermal expansion, 0.69%; 2-hour compressive strength, 4.0 MPa. Considering the coefficient of thermal expansion of gold alloy (15-16x10^{-6}/˚C), dimensional stability of soldered joint will not be negatively affected with the use of the soldering investment material.

Melting point of the Casting Gold M.C. Type IV alloy is 945˚C, whereas that of the Gold Solder material (66.6 Au, 11.4 Ag, 17 Cu, 2 Zn, 3 In, wt%) is 820˚C. The difference in melting point between the casting alloy and solder material could be controlled through the use of other solder material, i.e., K.16. Solder (66.6 Au, 10 Ag, 13.4 Cu, 4 Zn, 6 In, wt%; m.p.=760˚C; GC Corp.). Corrosion resistance of the K.16 Solder material (4 Zn, 6 In, wt%), however, would be inferior to that of the Gold Solder material (2 Zn, 3 In, wt%).

Unlike metal-ceramic restorations and FPDs, soldering of type 4 gold alloys must be completed before veneering procedure with composite resin. Care should be taken to minimize the deformation and degradation of connected areas when the components to be soldered are multi-unit or long-spanned.

Acknowledgments

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