—Communication—

Electro-optical Reflection Study on Corrosion of a Dental Alloy by Compound Iodine Glycerin in Artificial Saliva

Fumiyo KUSU*, Tomonobu HIRAI, Masamichi ISHIHARA†
and Kiyoko TAKAMURA

Received February 10, 1993; Accepted April 5, 1993

1. INTRODUCTION

For clarification of the physico-chemical characteristics of dental alloys, the electrochemistry of alloys in saliva has been extensively studied.¹⁻⁴⁾ However, interactions between dental alloy and orally administered drugs are but little understood. To prevent the corrosion of dental alloys, drug degradation and alloy dissolution, additional research is required. Compound iodine glycerin⁵⁾ is a germicides for pharyngitis and tonsillitis, and becomes easily attached to dental alloys used as prosthetic materials. Since electro-optical reflection method is useful for in situ observation of corrosion of metal with high sensitivity, examination was made of interactions between dental alloys and compound iodine glycerin by the method in the present study.

2. EXPERIMENTAL

A plate (7 mm x 10 mm) or disk (5 mm in diameter) of the dental casting Au-Ag-Pd-Cu alloy (Castwell MC, GC Dental Industrial Co.), containing 12% Au, 45% Ag, 18% Cu, 20% Pd and 5% others, was used as the working elec-

trode. The surface was polished with water-proof abrasive paper, 3 μm and 0.6 μm alumina sully, followed by washing in distilled water in a sonicator immediately before making measurements. An Ag/AgCl electrode and Pt wire were served as the reference and counter electrodes, respectively. Artificial saliva containing 6.8 mM NaCl, 5.4 mM KCl, 5.4 mM CaCl_2 , 5.0 mM NaH_2PO_4 , 0.02 mM Na_2S , and 17 mM urea (pH 5) was used as the supporting electrolyte solution. Compound iodine glycerin (I_2 1.2 %, KI 2.4 %, phenol 0.5 %, mentha water 4.5 %, glycerin 90 %) was purchased from Maruishi Pharmaceutical Co. Specular reflection was conducted as previously described.⁶⁾

3. RESULTS AND DISCUSSION

Figure 1 shows a cyclic voltammogram of the Au-Ag-Pd-Cu alloy obtained with the artificial saliva. The oxidation current potential was above 0.1 V mainly as a result of formation reactions of palladium oxide, AgCl, and CuCl. All these surface compounds dissolved at a negative potential less than -0.2 V. At less than -0.7 V, hydrogen evolution reactions occurred. The Au-Ag-Pd-Cu alloy was thus capable of remaining stable in artificial saliva -0.7 to 0.1 V. Examination of the cyclic voltammogram of artificial saliva containing compound iodine glycerin indicated the presence of a large reduction current peak at about -0.5 V in the first scan, and a pair of redox reac-

Tokyo College of Pharmacy (Horinouchi, Hachioji, Tokyo 192-03, Japan),
† Ishihara Dental Clinic (Hirayama, Hino, Tokyo 191, Japan)

Key Words: Electro-optical Reflection Method, Dental Alloy, Corrosion

tion peaks near -0.2 V. No redox reactions could be detected for phenol, mentha water, or glycerin, which is a component of compound iodine glycerin, at -0.7 to 0.1 V. Based on the redox potentials of materials present in compound iodine glycerin the first peak was considered to have been due to the reduction of I_2 to I^- , and the steady peaks, due to the formation of AgI and CuI and their dissolution on the Au-Ag-Pd-Cu alloy surface. When

0.1% compound iodine glycerin was added to artificial saliva, the rest potential of Au-Ag-Pd-Cu alloy changed by about 200 mV in a negative direction, indicating the rapid occurrence of alloy surface corrosion. Specular reflection indicated surface corrosion to be caused by the drug. Figure 2 shows a voltammogram and relative reflectivity (R/R_0) vs. E curve measured simultaneously in artificial saliva containing 2.5% compound iodine glycerin. As the potential became increasingly positive, a small hump and an oxidation wave became apparent on the voltammogram. This was accompanied by decrease in reflectivity on R/R_0 - E . In Fig. 3, charge in oxidation was plotted against change in R/R_0 ($|\Delta R/R_0|$). A linear relation between charge and $|\Delta R/R_0|$ was observed, with an

Fig. 1 Cyclic voltammogram of the dental casting Au-Ag-Pd-Cu alloy electrode in artificial saliva.

Fig. 2 Voltammograms (upper) and reflectivity-potential curves (lower) of the Au-Ag-Pd-Cu alloy electrode obtained with artificial saliva containing 0% (---) and 0.5% (—) compound iodine glycerin in the third scan.

Fig. 3 Relation between reflectivity change and charge required for the oxidation of the Au-Ag-Pd-Cu alloy electrode in artificial saliva containing 0.5% compound iodine glycerin.

inflection point at -0.2 V. The optical properties of surface products before and after change in potential would thus appear to differ. CuI may start to form at -0.3 V and AgI, at -0.2 V under the conditions of this study. The potential from -0.5 to -0.7 V ensures a stable surface without precipitate formation. However, it is difficult to maintain this potential in the oral cavity since the rest potential of cast repair material is ± 0.2 V.³⁾ It is evident from the present results that compound iodine glycerin, even at very low concentration, causes alloy surface corrosion in the oral cavity.

REFERENCES

- 1) S. Nomoto, N. Katsumata, T. Ogoshi, T. Tamura, T. Yokoyama, K. Otsuka and S. Nakamura, *Nihon Univ. Dent. J.*, **50**, 1059 (1980).
- 2) H. Kitsuta, M. Kawase, K. Orihara and Y. Ide, *Bull. Tokyo Dent. Coll.*, **29**, 67 (1988).
- 3) Y. Oda, S. Matsuno and T. Sumii, *Bull. Tokyo Dent. Coll.*, **29**, 59 (1988).
- 4) K. Endo, Y. Araki and H. Ohno, *Dent. Mater. J.*, **8**, 46 (1989).
- 5) Dai 12 Kaisei Nippon Yakkyokuhou Kaisetsusho, Hirokawashoten, Tokyo D-988 (1991).
- 6) F. Kusu and K. Takamura, *Denki Kagaku*, **53**, 361 (1985).