Elution of Nickel Ions from Dental Ni-Cr Alloy by Compound Iodine Glycerin in Artificial Saliva

Fumiyo KUSU*, Keiji OHE*, Masamichi ISHIHARA**
and Kiyoko TAKAMURA*

人工唾液中複方ヨードグリセリンによる歯科用 Ni-Cr 合金からの Ni イオンの溶出

楠 文代*, 大江慶司*, 石原正道**, 高村喜代子*

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Introduction

The elution of metal ions from dental casting alloys in various solutions has been extensively studied^{1), 2)}. These eluted metal ions sometimes cause allergic reactions in the human body³⁾⁻⁵⁾. However, the interaction of dental alloys with drugs in the mouth is not very well understood. When metallic ions are eluted from dental alloys by orally administered drugs, modification of their medicinal effects and/or allergic reactions may occur. These are very serious problems in drug therapy. Compound iodine glycerin, commercially available as "Lugol", a germicide for pharyngitis, attaches easily to dental alloys in the oral cavity. The present study was performed to examine the elution of metal ions from dental Ni-Cr alloy by this drug.

Experimental

A plate (7mm×10mm×1mm) of dental casting Ni-Cr alloy (Summalloy Nickel, SHOFU Dental Mfg. Co., composition given by the company as 84%Ni, 9%Cr) was used in this work. The surface was polished to a mirror-like finish with water-proof abrasive paper, 0.3μm and 0.06μm alumina powder, followed by washing in distilled water in a sonicator immediately before making measurements. For voltammetry, an SCE and Pt wire served as the reference and counter electrodes, respectively. Artificial saliva containing 6.8mM NaCl, 5.4mM KCl, 5.4mM CaCl₂,

5.0mM NaH₂PO₄, 0.03mM Na₂S and 17.0mM urea (pH 5.0) was used as the supporting electrolyte solution. Compound iodine glycerin (I₂ 1.2%, KI 2.4%, Phenol 0.5%, Mentha water 4.5%, Glycerin 90%) was bought from Maruishi Pharmaceutical Co. Concentrations of Ni and Cr elements were measured on an atomic absorption spectrophotometer (Shimazu, AA-646).

Results and Discussion

Figure 1- (A) shows an anodic polarization curve of Ni-Cr alloy of the first potential scan obtained in the artificial saliva. The oxidation current appeared at a potential positive than -0.4V. Elution of metal ions such as Ni ion in the solution seemed to occur at more than this potential. **Figure 1-** (B) shows a cathodic curve

Fig. 1 Voltammograms of (A) dental casting Ni-Cr alloy and (B) 10% Compound iodine glycerin solution measured using a gold electrode. Potential scan rate : 100mV/s

*School of Pharmacy, Tokyo Univ. of Pharmacy and Life Science (1432-1, Horinouchi, Hachioji-shi, Tokyo 192-03, Japan)

東京薬科大学 薬学部

**Ishihara Dental Clinic (41-3, Hirayama 2-chome, Hino-shi, Tokyo 191, Japan)

石原歯科医院

Fig. 2 Rest potential of dental casting Ni-Cr alloy in artificial saliva containing Compound iodine glycerin

Fig. 3 Rest potential dependence of amount of Ni ion eluted from dental casting Ni-Cr alloy in artificial saliva with Compound iodine glycerin.

of Compound iodine glycerin obtained using a gold electrode. The components of Compound iodine glycerin, except I_2 , gave no reduction current within the potential $-0.5 \sim 0.5V$. Therefore, the reduction current at less than $0.4V$ is attributed to reduction reactions of I_2 . When Ni-Cr alloy was immersed in a Compound iodine glycerin solution, the brown color of iodine gradually disappeared. Figure 2 shows the rest potential of Ni-Cr alloy immersed in a 2.0% Compound iodine glycerin solution. Compound iodine glycerin caused remarkable change in the surface potential of Ni-Cr alloy, i.e., from $-0.1V$ to $0.15V$. If the dissolution of Ni-Cr alloy and the reduction of I_2 occur at the same time, the corrosion potential might be about $0.15V$, on the basis of the voltammograms shown in Figure 1. This potential equals the surface potential of the Ni-Cr alloy in the presence of Compound iodine glycerin. The Ni-Cr alloy was immersed in artificial saliva containing Compound iodine glycerin of several concentrations, and the solution was stirred for 30 minutes. Simultaneously, the rest potential of Ni-Cr alloy was measured against SCE. The amount of Ni ion eluted from Ni-Cr alloy in the solution was plotted against each concentration of Compound iodine glycerin up to 3.0%. Ni ions were slightly detected when the Ni-Cr alloy was immersed in artificial saliva without Compound iodine glycerin. When a larger amount of Compound iodine glycerin was present, the amount of Ni ion increased. Cr ion was detected in the presence of more than 0.5% of Compound iodine glycerin. Figure 3 shows the amount of Ni ion plotted

against the rest potential of Ni-Cr alloy. The Ni ion concentration increased as the rest potential was shifted to the positive potential side by the increase in the concentration of Compound iodine glycerin. The amount of Ni ion increased suddenly at $0.4V$. Therefore, at this corrosion potential, oxidation of Ni occurred, and I_2 was reduced at the surface of the Ni-Cr alloy.

Conclusion

It is evident from the present study that Compound iodine glycerin, even at very low concentrations, causes elution of Ni ion from Ni-Cr alloy in the oral cavity. In the practical use of Compound iodine glycerin, this drug and Ni-Cr alloy come into contact for a few minutes in the oral cavity. We believe that a very small amount of Ni and Cr ion elutes from the surface of the Ni-Cr alloy. However, there will be a serious problem as people could be sensitive to an allergic reaction.

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