Online publication ahead of print, AJMHS Vol 49, 2018

Forensic odontological application for dental restorations in case of skeletal remains using energy-dispersive X-ray fluorescence spectrometry

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Abstract

Background: We applied energy-dispersive X-ray fluorescence spectrometry (EDX) for elemental analysis of dental restorations in a case of skeletal remains. This identified high peaks corresponding to silver, palladium, copper, and gold, matching gold-silver-palladium alloy. Our results suggest that EDX may serve as a useful tool in the field of forensic odontology and provides valuable information.

Key words: Energy-dispersive X-ray fluorescence spectrometry, simple test, dental restorations, alloy

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INTRODUCTION

Elemental analysis using energy-dispersive X-ray fluorescence spectrometry (EDX) has been reported as a useful tool in the fields of forensic pathology and toxicology, allowing detection of various toxic or specific elements, such as mercury, lead, bromine, sulfur, silicon, titanium, magnesium, iron and copper (1-12). We report herein the application of EDX for elemental analysis of dental restorations, providing useful information for forensic practice.

Case report

Skeletonized remains were found in a vehicle salvaged from the sea. Medico-legal autopsy revealed no clear injuries on the skeletal remains. Three kinds of dental restoration were observed in the maxilla and mandible (Figure 1). Subsequent investigation by the authorities and DNA analysis identified the victim as a man in his sixties who had gone missing approximately 9 years earlier.

Figure 1. Dental restorations in the mandible.

An EDX instrument (Rayny EDX-720; Shimadzu, Kyoto, Japan) was employed for elemental analysis of the dental restorations. In brief, operating conditions for the EDX were as follows: target, Rh anode; operating voltage, 50 kV; X-ray path, air; detector, Si (Li); and measurement time, 100 s (4).

For EDX examination, the metal crown was wiped off the surface then directly placed on a sample cup (double open-end X-RA; Shimadzu) with polyester thin-film (Mylar film; Shimadzu) (4). The sample cup was placed on the sample stage of the equipment without any further preparation. Identification of elements was based on the unique energy characteristics of X-ray fluorescence emitted from the sample.

Results and Discussion

Figure 2 shows the EDX spectrum of the dental restorations from the victim.

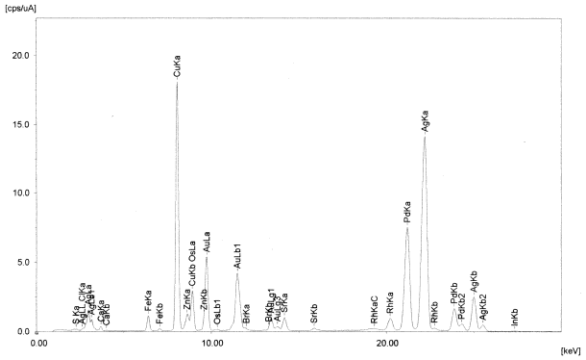

Figure 2. EDX spectrum of dental restorations from the present case.

High peaks due to silver, palladium, copper, and gold are detected in the present case.

Relatively high peaks corresponding to silver, palladium, copper, and gold were identified in the dental restorations. All three metal crowns showed similar results. Those elements are components of a gold-silver-palladium alloy used in dental care (13). This gold-silver-palladium alloy is widely used as a material in dental treatments covered by the national health insurance system in Japan. However, other metals such as titanium are also used in treatments not covered by national health insurance. The elements of dental restorations may represent useful information for personal identification and suggest the economic circumstances of the victim.

Elemental analysis has been reported as a method for forensic dental identification (14). EDX analysis is useful as a simple test for elemental analysis of various kinds of substances. This method can be used for rapid and simultaneous multi-element analysis without any special sample preparation. The present results show the applicability of EDX analysis in the field of forensic odontology. Further applications of EDX in forensic practice can be expected.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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