STUDIES ON THE COMPOSITION OF HUMAN DENTAL CALCULUS

DETERMINATION OF SOME MAJOR AND TRACE ELEMENTS BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

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The concentrations of Ca, Mg, Na, K, Cl, Zn, Sr, Mn, Ba, Br, and Au were determined in individual samples of dental calculus collected from patients resident in the Manchester area. The method used was instrumental neutron activation analysis (INAA), combined with gamma-spectrometry. The highest and lowest values of Sr were found in calculus from patients of Asian origin. No differences were found in the elements studied with regard to sex or age. Individual variations were highest in Au and lowest in Ca.

Introduction

Dental calculus is a hard calcified deposit which occurs above (spura-) or below (sub-) the gum margin. Studies by X-ray diffraction analysis\(^1\)\(^-\)\(^3\) have revealed the presence of four types of calcium phosphate crystals in the majority of the calculus samples: brushite, octacalcium phosphate, magnesium containing Whitlockite and carbonate containing hydroxyapatite. Since plaque is believed to play a significant role in dental caries, the need to seek a greater understanding of calculus formation and composition is important. There is, however, little information in literature about the concentration of trace elements in dental calculus. The question of whether there are dissimilarities in the composition and biochemical properties of the oral fluid or calculus deposits which would explain the great divergence in the intensity of calculus formation between one individual and another is not clear. Pooled samples of calculus were used in the analysis of several elements by RETIEF et al.\(^4\),\(^5\) These studies would not give much information about the individual variations of their calculus composition. There are, however, very few studies\(^6\),\(^7\) which considered individual analysis of calculus. LUNDBERG et al.\(^6\) included 7 patients in the analysis of 6 elements by radiochemical NAA. The study showed that only Na and Sr were
statistically significantly higher in the subgingival calculus, which was collected after tooth extraction, than the supragingival calculus collected prior to extraction. In Finland KNUUTTILA et al. applied atomic absorption spectrophotometry to determine the concentration of Ca, Mg, Mn, Sr and Zn in calculus. Supragingival calculus was taken from the surface of enamel and amelocementum junction of the mandibular anterior teeth. The study showed that Zn and Sr were significantly higher in subgingival samples. Manganese was higher in supragingival calculus while Ca was very similar in both types.

Comparison of these studies is difficult due to the variation in sampling procedures and methods of analysis. In addition, geographical location, oral environment or dietary habits may influence the composition of calculus.

The present study was undertaken as a preliminary investigation on the composition of individual samples of calculus for some selected major and trace elements.

**Materials and methods**

**Sample collection**

Calculus was obtained from patients at the University of Manchester Dental Hospital. The age of patients varied between 22–70 years and there was no information available about the age of calculus. All subjects were resident in the Manchester area which has about 0.07 ppm F in the water supply. Samples which were heavily contaminated with blood or were of uncertain origin were discarded. Both, sub and supragingival calculus samples were collected from each patient using standard scaling instruments.

**Sample preparation**

Immediately after collection, samples of calculus were washed thoroughly with double distilled water and dried in an oven at 100 °C to a constant weight. Care was taken to avoid contamination from glassware, or metallic tools. The amount of calculus in each sample ranged from 1–50 mg dry weight. Calculus was assessed as follows:

1. Supragingival;
2. Mixed (supra- and subgingival);
3. Pooled mixed (collected from more than one patient).

The majority of samples were from the second group. In the pilot investigations, pooled samples were used.