Incompatibility of dental alloys: Evaluation by ec-pen corrosion measurements

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INTRODUCTION: Metallic reconstructions of crowns, bridges and/or prosthesis exposed to the conditions in the oral cavity have varying corrosion resistances. Metal ion diffusion due to redox reactions of the reconstructions can cause symptoms including pain and irritations of the mucous membrane, taste irritations, dry mouth or tongue burning. Patients suffering from these incompatibility reactions are examined using time-consuming evaluations. Energy-dispersive X-ray (EDX) spectroscopy of splints from the metallic dental reconstruction is applied to know their composition followed by an atomic absorption spectroscopy (AAS) of the surrounding soft tissue to evaluate if it contains some of the metals comprised in the dental construction. The results may allow concluding that the metals used for constructions corrode. A rather fast and supportive *in vivo* method for such an analysis is an electrochemistry technique termed ec-pen used for more than nine years. In this presentation, the challenges during the measurement and analysis are discussed.

METHODS: The ec-pen has a setup similar to a cyclic voltammetry experiment. The pen itself contains a working electrode (WE) and a reference electrode (RE) both immersed into the electrolyte (lactic acid 10.01g/L – sodium chloride 5.8g/L in distilled H_2O), which is enclosed in the reservoir within the pen. By pressing the pen tip against the material of interest, it emits some of the electrolyte causing a wetting of the construction surface and, therefore, allows for the electrochemical analysis as soon the counter electrode (CE) is in contact with the construct as well, see Fig. 1. More detailed description of the ec-pen setup and functionality has been discussed previously [1-4].

RESULTS: To obtain appropriate results it is of particular importance, where and how the measurements are carried out. Depending on the contact and wetting area of the pen tip, the results can deviate significantly. Therefore, it should be well documented, where and how the measurements are taken (tip angle relative to the construction, crown area/edge, soldering points, crevice etc.). These deviations are demonstrated on the construction displayed in Fig. 1 and summarised in Table 1.

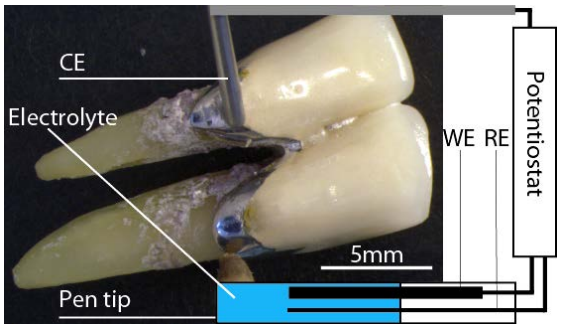

Fig. 1: The ex vivo measurement set up of a metallic dental construction using the ec-pen.

Table 1. The results depend on contact area and location.

	Impedance [Ω cm^2]	Phase [degree]
Tip 90° rel. to sample	354 ± 119	50 ± 6
Tip 45° rel. to sample	206 ± 65	48 ± 10
Crown area	262 ± 83	49 ± 14
Crown edge	307 ± 92	11 ± 16
Base	186 ± 48	37 ± 4
Soldering point	60 ± 4	27 ± 3

DISCUSSION & CONCLUSIONS: Albeit one can identify such deviations it was possible to seriously evaluate the dental constructions of more than 120 patients with material's incompatibility reactions. The results of the evaluation compared with EDX and AAS showed that the ec-pen method is a valuable alternative to get results concerning corrosion induced incompatibility reactions in patients within minutes. The authors recommend the growing number of people, who suffer from irritations in the oral cavity, to consult the specialized dentists at the University of Basel.

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