ON COBALT CHROME FRAMEWORKS IN IMPLANT DENTISTRY

AKADEMISK AVHANDLING

Som för avläggande av odontologie doktorsexamen vid Göteborgs universitet kommer att offentligen försvaras i föreläsningssal 3, Odontologiska institutionen, Sahlgrenska akademin, Göteborg, fredagen den 11 december 2009

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Avhandlingen är av sammanläggningstyp och baserar sig på följande delarbeten:

I **Hjalmarsson L, Örtorp A, Smedberg J-I, Jemt T.** Precision of Fit to Implants: A Comparison of Cresco™ and Procera® Implant Bridge Frameworks. *Clinical Implant Dentistry and Related Research, in press.*

II **Hjalmarsson L, Smedberg J-I, Wennerberg A.** Material degradation in implant-retained cobalt-chrome and titanium frameworks. *Submitted for publication.*

III **Hjalmarsson L, Smedberg J-I, Aronsson G, Wennerberg A.** Cellular responses to cobalt-chrome and CP titanium: an in vitro comparison of frameworks for implant-retained oral prostheses. *Submitted for publication.*

IV **Hjalmarsson L, Smedberg J-I, Pettersson M, Jemt T.** Implant level Cresco-prostheses in the edentulous upper jaw. A comparison with conventional abutment level prostheses after 5 years in function. *Submitted for publication.*

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ON COBALT-CHROME FRAMEWORKS IN IMPLANT DENTISTRY

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Abstract

Background: Cobalt-chrome (CoCr) alloys have been used in dentistry in decades but very little is known about their behavior and biological impact as framework materials in implant dentistry. Furthermore, few studies have evaluated and compared the clinical and radiological results of abutment and abutment-free implant treatment concepts. **Aims:** To investigate *in vitro* cobalt-chrome and commercially pure (CP) titanium frameworks regarding precision of fit, estimated material degradation and possible adverse cellular responses. In addition, to retrospectively evaluate the clinical and radiological five-year outcome of abutment-free porcelain-veneered cobalt-chrome prostheses compared to acrylic-veneered CP titanium prostheses, with or without abutments. **Materials and methods:** *Paper I.* Two groups of cast, sectioned and laser-welded frameworks were fabricated, either in a CoCr alloy or in CP titanium. A third group comprised computer numeric controlled (CNC) milled CP titanium frameworks. Measurements of fit were performed with a coordinate measuring machine. *Paper II.* Ion leakage from titanium implants, CoCr and CP titanium framework sections into artificial saliva was observed with mass spectrometry. Surface structures were registered with optical interferometry. *Paper III.* Viability of epithelial cells and fibroblasts cultured on cobalt-chrome and titanium specimens were evaluated with the Alamar Blue™ method. Specimen surface structures were registered with optical interferometry and cell morphology observed with SEM. *Paper IV.* A test group (n=40) comprised of patients treated with prostheses made at *implant level* in dental-porcelain veneered CoCr alloy (n=15) or acrylic-veneered CP titanium (n=25). A control group (n=40) was provided with prostheses made at *abutment level*, in acrylic-veneered CNC-milled CP titanium. Clinical and radiological data were evaluated after five years. **Results:** *Paper I.* The transversal width decreased in CoCr frameworks, but increased in both groups of titanium frameworks. Less vertical distortions were present in the CNC-milled frameworks compared to the two other groups. *Paper II.* Significantly more cobalt ion leaked than titanium and chrome ions. Both framework sections and implants roughened after saliva exposure. *Paper III.* Both cell groups were more viable on titanium than on CoCr surfaces. The CoCr surfaces had a lower height deviation but were denser than the CP titanium surfaces. No major deviations from normal cell morphology were present. *Paper IV.* No significant differences in implant cumulative survival rates were demonstrated between the test and control groups after five years in function (98.6% and 97.6 %, respectively). No major differences in bone levels were demonstrated. Mucositis and veneer fracture were the most common complications in all groups. **Conclusions:** None of the frameworks presented a perfect, completely "passive fit". There were indications of active corrosive processes for both implants and framework materials. Epithelial cells and fibroblasts preferred titanium to CoCr surfaces. The clinical outcomes of *implant level* prostheses made of porcelain-veneered CoCr or acrylic-veneered titanium seem comparable to acrylic-veneered titanium prostheses made at *abutment level*.

Key-words: cobalt-chrome, titanium, implants, misfit, corrosion, viability, abutment-free
ISBN 978-91-628-7923-5; **ISSN** 0348-6672; Swedish Dental Journal Supplement 201, 2009
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