

On Biological Response and Wear Particles around Oral Implants and Implant Components

Akademisk avhandling

Som för avläggande av odontologie doktorsexamen vid Sahlgrenska akademien,
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av

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Avhandlingen baseras på följande delarbeten

- I. J. Olander, A. Wennerberg and V. F. Stenport. Implant-Supported Single Crowns with Titanium or Zirconia Abutments: A Retrospective Up-to-5-year Follow-up Study. *The International journal of prosthodontics* 2022 vol:35 iss:4, 387–395
- II. J. Olander, A. Ruud, A. Wennerberg, and V. F. Stenport. Wear particle release at the interface of dental implant components: Effects of different material combinations. An in vitro study. *Dental Materials* 2022 Vol. 38 Issue 3, 508–516
- III. J. Olander, AK. Östberg, K. Christenson, P. H. Johansson, A. Wennerberg, V. F. Stenport. Inflammatory response to wear particles: comparisons between zirconia and titanium in vitro. *In manuscript* 2023.
- IV. Olander J, Barkarmo S, Hammarström Johansson P, Wennerberg A, Stenport VF. Inflammatory Gene Profile and Particle Presence in Peri-Implant Mucosa: a Pilot Study on 9 Patients. *J Oral Maxillofac Res* 2023;14(3):e2

**SAHLGRENKA AKADEMIN
INSTITUTIONEN FÖR ODONTOLOGI**



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Abstract

Background: Wear particles released from implant components are gaining interest in the dental literature.

Aim: The overall aim of this thesis is to determine whether the combination of different materials in the dental implant construction causes alterations in the biological responses and wear particle release.

Patients and method: In the first study (I) data from patients, treated at a specialist clinic with single implant crowns manufactured out of two different abutment materials, were retrospectively analyzed regarding clinical outcome variables after up to five-year in function. In study II, experimental dynamic loading was evaluated for comparisons of wear, corrosion, and wear particle generation, using two abutment materials connected to two different types of implant materials. In study III the proinflammatory response from PBMCS (Human peripheral blood mononuclear cells) exposed to two types of disc materials combined with particles from two different materials was investigated. In study IV mucosa biopsies from patients treated with single implant supported crowns of two types of abutment materials were evaluated with regards to presence of wear particle and gene expression.

Results: Study I: Implants with zirconia abutments showed an increased bone loss compared to titanium abutments, and the opposite was seen regarding technical complications. Study II: Wear signs were found on all implants, regardless of abutment material. No clear difference was seen comparing material combinations. More particles were found to be released when using zirconia abutments on titanium implants. Study III: Titanium particles and discs generated a higher proinflammatory response compared to zirconia. Neutrophils reacted to zirconia particle by releasing neutrophilic extracellular traps. Study IV: Titanium wear particles was found in soft tissue samples, zirconia particles found on implant heads. More particles were found in mucosa around zirconia abutments. Gene expression showed upregulation of several proinflammatory genes when using zirconia abutment compared to titanium.

Conclusion: Wear particles may trigger pro-inflammatory reactions in the peri-implant mucosa.

Keywords: Dental implants, zirconia, titanium, wear particles, gene expression