MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, December 14 2022 at 13:30, D. Dan and Betty Kahn Building, Auditorium 1.
Online: https://technion.zoom.us/j/91948184469

From Bio-Compatible to Bio-Rejected: Mechano-chemical surface effects on dental implant rejection

Amit S. Shavit

Advisers: Prof. Daniel Rittel and Dr. Keren Shemtov-Yona

The most common materials for dental implants fabrication are Titanium and its alloys. These metals are considered biocompatible due to their passive oxide layer which promotes the osseointegration process. Peri-implantitis is a common disease caused by bacterial biofilm, in which a dental implant progressively loses its bone anchorage and often has to be removed. The titanium oxide layer, which is in direct contact with the bacterial biofilm and the inflammation process during the disease progression, is probably affected by the environmental changes caused by it. This degradation might modify the surface oxide properties, rendering it from bioinert to bio-toxic, and leading to its rejection.

The study systematically collected, and document failed titanium dental implants that were removed from patients due to peri-implant disease, which have already lost most of their bone support and were deemed hopeless. Next, a thorough evaluation of the implants' surface was carried out using high resolution characterization methods such as HR-SEM, ToF-SIMS, and S/TEM on representative locations along the failed implant, and the oxide layer nature (thickness, microstructure, and integrity) was determined together with a detailed characterization of the implant's surface composition. The analysis included a comparison with reference ("out of the box") unused implants with an intact native titanium oxide layer.

The analysis has shown a clear change in the surface composition along the implant's length. Areas which were still anchored to the bone have shown a surface composition like that of reference unused implant while in the used implant's titanium oxide layer was found to be inconsistent in its width with large areas occupied by organic contaminations. In addition, micron scale damage was also observed with the release of particles from the surface, mainly in the top areas of the implant where the inflammation originates.

The study identified alterations of the titanium surface oxide layer properties, oxide layer thickness, continuity, microstructure, impurity's element content and amount, all of which can be tentatively correlated with the disease progression and possibly hinder the reestablishment of bone anchorage (re-osseointegration) even once the biofilm is removed and the inflammation ceased.

Seminars Coordinator: Assoc. Prof. Matthew Suss.