

Hybrid Zirconia Dental Implant: Proof of concept

Joana Mesquita-Guimarães^{1,2}, Luís, Martins-Pereira¹, Joaquim, Pinho-Da-Cruz^{1,2}, António Pereira^{1,2}, António Completo^{1,2}

¹ Centre for Mechanical Technology and Automation (TEMA), Department of Mechanical Engineering, University of Aveiro, Campus Universitario de Santiago, Aveiro, 3810-193, Portugal

² LASI—Intelligent Systems Associate Laboratory, Aveiro, Portugal

Zirconia dental implants are a highly attractive product due to being a metal-free alternative to titanium implants and high-end esthetic results favourable as background to thin soft tissue, as well as considered to reduce affinity to bacterial plaque.

Nevertheless, the high Young's Modulus mismatch of zirconia translates into a high-stress shielding between bone (0.5 to 20 GPa) and the zirconia dental implant (~200 GPa), being associated with severe bone mass loss.

Having that in mind, a hybrid zirconia-PEEK dental implant was developed and processed via additive manufacturing using a digital light processing technique, as well as one group of the reference zirconia implant similar to the Straumann® PURE Ceramic Implant Monotype Ø 4.1 mm RD, and another group of implants with a longitudinal hollow to allow UV-sensitive resin debinding step without cracks. The zirconia dental implant body was designed with a gradient octet-truss porous structure in the screw part and later infiltrated with PEEK using the lost wax technology. After that, a screw was performed with a rotatory machine.

The prototypes were analysed in terms of their structural quality, and compressive and fatigue tests were performed. The hybrid zirconia-PEEK dental implant showed extensive plastic deformation, and the hollowed implant showed fatigue resistance similar to Titanium implants.