AAID Foundation Large Research Grant Application: 2021

Final Grant Report

Principal Investigator: Les Kalman

Title of Research Project:
In Vitro Testing and Assessment of Additive Manufactured Solid and Lattice-Structured Zirconia Implant Overdenture Bars

First and foremost, I would like to sincerely thank the AAID for the financial support of this research, which could not have occurred without support.

Budget Details
The final financial report has also been emailed from Femi Ogunsanya.

Project Activities
Project activities were within the research plan. We successfully designed and fabricated zirconia solid and lattice structured implant bars. The bars underwent testing. Data has been generated. The project was presented at the HI-AM Conference in Halifax, Canada. Please see abstract attached as appendix for further details and results.

The project is complete, but still requires analysis of the data. We have also explored a unique development, where we have an approach to create a modulated bar and then approach AM fabrication, without digital design. The impact of the research remains high, as we have not seen other research exploring AM zirconia bars, lattice zirconia bars or a novel approach for fabrication without digital design. The research will have an impact on implant dentistry, restorative dentistry, AM and material science.

This investigation was challenging. I underestimated the time needed to execute the deliverables, as the AM fabrication process and testing went well beyond expected time frames. It has also been challenging to do all the research on my own, especially when my research component was reduced, but this has also been very satisfying. For future research, I will explore collaboration with other investigators and student or graduate assistance.

The next steps will be to analyze the data and formulate a manuscript for publication and future presentations. I will also be exploring the AM fabrication pathway without digital design in more detail.

Once again, thank you for the support and please advise if anything else is required. Could I kindly ask that the last installment of the grant be forwarded, as the research has ultimately concluded.

Regards,

Les Kalman

Appendix I: HI-AM Abstract

HI-AM Conference

6th | 2023

HOLISTIC INNOVATION IN ADDITIVE MANUFACTURING

JUNE 27 & 28 | HALIFAX, NS, CANADA
nserc-hi-am.ca/2023

PARTICIPANT INFORMATION PACKAGE

NSERC HI-AM | UNIVERSITY OF WATERLOO | NSERC CRSNG | INNOVATION.CA CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

Solid and Lattice-Structured Additive Manufactured Zirconia Dental Implant Bars: In Vitro Testing and Assessment

Dental implant bars are exclusively fabricated through milling, which represents a workflow that is costly and inefficient. Additive manufacturing is having a significant impact on dentistry, due to efficiency, cost effectiveness and sustainability. Recently, additive manufacturing in zirconia has been introduced as a result of advances in technology. This investigation will fabricate solid and lattice-structured implant bars through AM in zirconia, and assess flexural strength and stiffness, fit, finish and denture compatibility. A dental implant solid and lattice bar will be optimized with software and fabricated using AM with LithaCon 210 3Y zirconia. The solid and lattice bar will be printed twelve and five times, respectively. Bars will be post processed (cleaned, debinded, sintered and inspected). The bars will be subjected to mechanical testing to assess flexural strength and stiffness. Bars will also be fitted to the simulated patient model and assessed for (1) clinical acceptance (2) surface finish and (3) support and retention of a denture (all in progress). The findings of this study will provide new and important data regarding the AM workflow of zirconia implant bars and offer critical metrics for clinical translation.

Biography of presenting author

Kalman is an assistant professor in restorative dentistry with a research focus on medical devices and technologies. He has delivered conference talks, presentations and CE courses locally, nationally and internationally and has more than 60 research publications, reviews, book chapters, editorials and case reports. He holds patents and has translated several technologies to industry. He has served on the Board of Directors for UWOFA & the CAPHD. He has been recognized as an Academic Associate Fellow (AAID), Fellow, Master and Diplomate (ICOI), Fellow (AO), a Schulich Alumni of Distinction and received the Merck Patients First and a CES Innovation award.