

Orthodontic Faculty Development Fellowship Award

Dr. Jonas Bianchi, *University of the Pacific, Arthur A. Dugoni School of Medicine*

Project title. Machine Learning Approaches for Segmentation and Integration of Root Canal and Dental Crown.

Award Recipient. Dr. Jonas Bianchi, Assistant Professor of Orthodontics– University of the Pacific, Arthur A. Dugoni School of Dentistry.

Biography. Dr. Bianchi is a full-time Assistant Professor of Orthodontics at the University of Pacific in San Francisco - CA. He graduated from the State of Sao Paulo University in Brazil with a master's, and his Ph.D. was done in collaboration with the University of Michigan, where he completed a post-doctoral fellowship under the mentorship of Dr. Cevidanes. His research is centered on data science approaches and artificial intelligence to create decision support systems in dentistry. He also works with Dr. Heesoo Oh at the Craniofacial Research Instrumentation Laboratory (CRIL) and orthodontic residents from the University of the Pacific in research activities. In addition, he actively collaborates with the University of Michigan under an R01-funded grant (PI Dr. Cevidanes), State of Sao Paulo University, and the University of North Caroline (USA) using CBCT images, digital dental models, and patient clinical data to improve clinical decision making based on data science approaches. In the orthodontic practice, Dr. Bianchi has an evidence-based approach using different protocols and personalized treatment with segmented mechanics, straight-wire techniques, TADs, and orthopedics appliances.



Brief description of the project. The advances in technology in this century are changing healthcare and personalized dental care. The number of acquired data from multi-source exams and the storage capacity has increased at an accelerated rate. For this reason, data science approaches are needed to standardize variables and perform adequate data management, integration, processing, and visualization. Machine learning methods are an emerging research topic requiring precise and specific features to train a model to classify patients' conditions, diseases, images, and the creation of decision support systems. Digital dental models (DDM) and CBCT images have been widely used for treatment planning and orthodontic aligners therapy in orthodontics. The root shape and position are also of great value for root canal preparation, planning of orthodontic movement, and restorative and implant dentistry. Significant challenges exist in predicting the root position since the DDM contains only the crown surface information and accurately segments the crown. However, traditional digital orthodontics setup software usually only provides crown surface information and demands time, and a third part company is needed for the image pre-processing. Thus, this application's innovation uses image processing methods and machine learning approaches to automatically segment crown surfaces from digital dental models (DDM) obtained by intraoral scanners, and segment root canals from cone-beam computed tomography (CBCT), and combine those data into a single merged 3D digital dental model. We hypothesized that our models can accurately segment the roots and crowns compared to manual processing. Our long-term goal is to use those tools to create decision support systems in orthodontics to help the clinician in the decision-making process in orthodontics therapy using aligners or fixed appliances with a virtual setup.

Statement of how orthodontic education will benefit from your award. We propose to disseminate the tools in an open-source environment. We expect to provide to orthodontic residents and clinicians a platform where they can upload their data (CBCT and Digital Models) and obtain a final model with the roots and crowns segmented into a single 3D model. This will positively impact orthodontic education since the treatment planning with an integrated 3D model will contain information about the roots, making the digital setup realistic to each patient's condition/phenotype.

Why the Foundation is important to your project. The AAOF has a vital role in this project. With the results from this study, we proposed to use our preliminary data as part of an R01 submission towards data science, decision-making systems, and AI approaches in dentistry.

How Foundation funding is expected to or has benefitted your career. The AAOF has a great impact on my role as a Professor. With the financing of our research, I'm able to proceed with the best interest in my career, aligned with state-of-art research, which is the education of our future orthodontists with critical thinking and excellent clinical skills. I also maintain a positive environment and a strong desire to pursue excellence in Orthodontics Research because the AAOF can support its members and encourage them to be a better Professor with the Faculty Development Fellowships award.