

# EXPLORATIONS

JOHN C. GREENE SOCIETY NEWSLETTER  
 SPRING ISSUE 2021



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Student researchers presented their projects virtually at the annual UCSF School of Dentistry Research and Clinical Excellence Day. Turn to **page 4** for a summary of Dr. Darnell Kaigler's plenary speech on the future of dentistry, and **page 12** for an interview with student dentist Eric Coy on his project of developing machine-learning software that can automatically score plaque.

# LETTER FROM THE PRESIDENT



Dear Members of the UCSF Dental Community:

The past two quarters have been a whirlwind, and I'm pleased to share with you this new edition of Explorations that covers research conversations from the past several months.

Research and Clinical Excellence Day was an awesome success, and I'm super appreciative of everyone who participated and made it happen. I had the privilege of being on the RCED planning committee and saw firsthand how much intention and deliberation went into organizing this enormous event. Special thanks to Roger Mraz, Dr. Berens, Dr. Knox, Dr. Gansky, and Dr. Nguyen for their incredible dedication to this project and the research community at UCSF as a whole.

Dr. Kaigler's and Dr. Stewart's presentations at RCED gave encouraging reflections on the future of dentistry as a synergy of art and science, and what it means to be a master clinician. These presentations highlighted two key features in dentistry that our school treasures: research as a means of advancement, and humble practice as a path to mastery. Arguably every single research project at RCED exemplified a commitment to these ideas – students worked especially hard during the pandemic to see their projects through, and their perseverance merits celebration. Moreover, the sheer breadth of topics investigated was amazing – projects ranging from facial aesthetics to dental therapy education to jaw development were presented with great depth. I'm humbled to be surrounded by such brilliant students and colleagues who were able to demonstrate excellence in research even in a pandemic: fantastic minds committed to art and science, and masters of dentistry in the making.

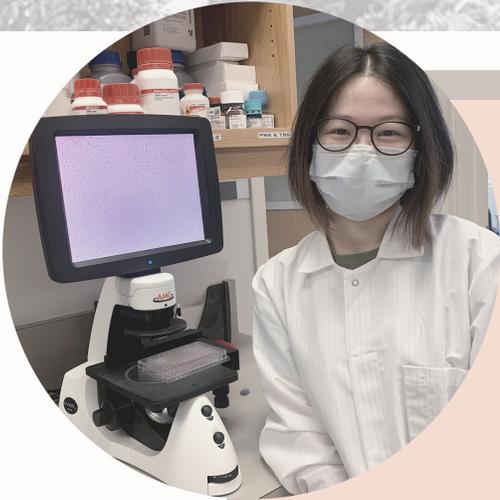
I'd be remiss if I didn't also acknowledge the monumental contributions of faculty mentors. This year, mentors had dual obligations of mentoring and managing pandemic curveballs. Regardless, students still had enriching research experiences and spoke highly of their mentors, evidenced by the glowing nominations we received for the Mentor of the Year Award. Congrats to Dr. Misun Kang for receiving this award: her resilience and kindness surely left an impact on her mentees. And special thanks to all the other mentors out there – your investment in us students means a lot.

I hope you enjoy this edition of Explorations – our illustrious newsletter team worked hard to put together this killer newsletter. Stay safe and vigilant, and I wish you all the best.

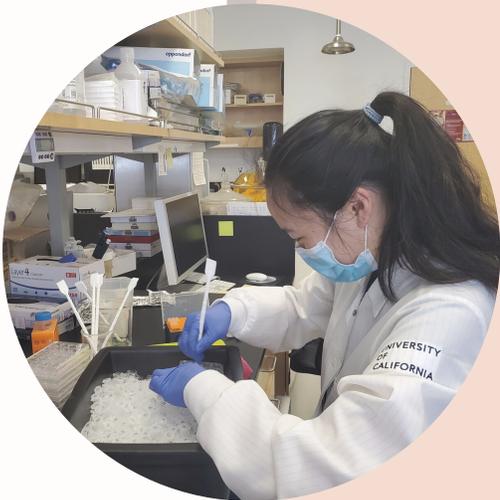
Wesley Kao

A handwritten signature of Wesley Kao in black ink.

# THE JOHN C. GREENE SOCIETY



*The John C. Greene Society was founded in 2002 under the mentorship of Dr. John S. Greenspan and Dr. John C. Greene, whose leadership was instrumental to the dental school's rise to prominence as a premier research institution. A major goal was to encourage active student participation in meaningful research, bringing student research into alignment with the quality investigations being conducted by the UCSF dental faculty.*



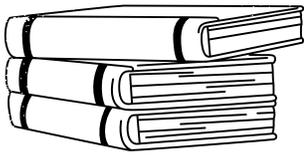
*Since that time, the John C. Greene Society has grown into one of the most recognized and respected student groups on campus. Student research participation at UCSF is at an all-time high, with dozens of students conducting fellowships each year, and many more traveling to present their findings at conferences across California, the country, and the world.*



*2020 Summer Research fellows conducting their respective research: Joy Geng '23 (Top) at the Kapila lab, Tiffany Huang '23 (Middle) at the Schneider lab, Alexander Le '23 (Bottom) doing remote research with the Lazar lab.*

# PLENARY SPEAKER: DARNELL KAIGLER

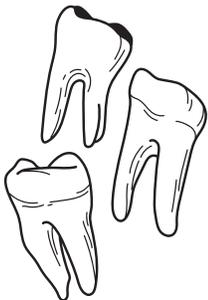
*Dr. Darnell Kaigler is an Associate Professor in the Department of Periodontics and Oral Medicine in the School of Dentistry and Biomedical Engineering in the College of Engineering at the University of Michigan. Here, we recap Dr. Kaigler's plenary speech on the field of dentistry in 2021 and beyond.*



Dr. Kaigler was the first individual to complete a dual DDS/PhD at the University of Michigan, and he has received additional certificates in operative dentistry and periodontics, and in clinical research design and statistical analysis. Currently, he leads an active research program that focuses on the development and implementation of stem cell-based therapies for the regeneration of oral tissues.



To Dr. Kaigler, achieving good oral health is more than just having healthy teeth. It is being free of oral-facial pain, oral and pharyngeal cancers, soft tissue lesions, and more. The future of dentistry is dependent on targeting these conditions and developing the tools necessary to personalize patient care and management. To train clinicians who are able to put this into practice, modern dental education needs to focus on critical thinking skills and developing students into life-long learners.

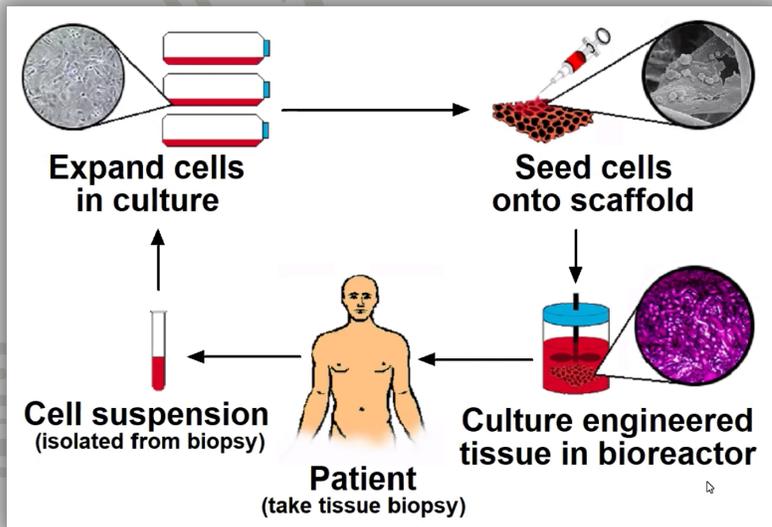


According to Dr. Kaigler, technologies from other venues have had significant and potential applications in dentistry and will continue to do so. For instance, robotics can help precisely plan for invasive procedures. Teledentistry can enable us to connect with patients who have limited access to dental care. Ultrasound technology can be used to measure bone loss and detect caries without the use of radiation. CRISPR is starting to change medicine and has huge implications on how we treat head and neck cancer. Artificial intelligence enables data assimilation and helps come up with algorithms to diagnose, prognose, and plan for treatments. Virtual reality and augmented reality enables virtual simulation to train for different scenarios before clinical procedures and test new materials. 3D printing and CAD/CAM already have had significant implications in dental labs and clinics but could be further developed into improving existing treatments. Customized oral hygiene therapy and smart toothbrushes are just stepping stones into personalized dental care. The current technology continues to mold the way clinicians deliver care.



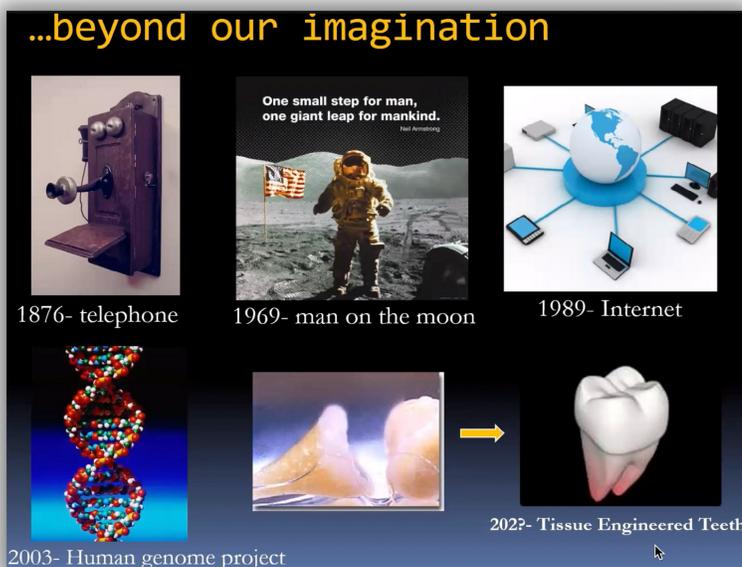
Dr. Kaigler also presented some of the work that his research lab conducts. Along with Dr. Mendoca and Dr. Li, he performed a maxillary full arch reconstruction using fully digital techniques, set up of the patient, mounting, and articulating of the case were all done virtually, and were followed by the digital generation and 3D printing of provisionals and surgical guides.

“Every patient has a different history and varying habits. Some patients are more susceptible to certain diseases due to their differences in genetics. Clinicians must examine and learn to think more critically and manage patients based on individual risks and knowledge of the genome.”



Left: Tissue engineering scheme (Kaigler, Mooney et al, *J Dent Educ* 2001) used to be a conceptual schema. But 10 years later, Dr. Kaigler's group has been able to apply stem cell therapy to engineer and regenerate alveolar bone tissue for use in the clinic.

Additionally, his lab has made strides in the field of regenerative medicine, which uses living cells in a variety of ways to restore, maintain, or enhance tissues and organs. In their first randomized clinical trial to evaluate stem cell therapy for craniofacial application, the lab used the extraction socket as a model for bone regeneration. In the trial, they saw regenerative response as early as 6 weeks. They were able to treat and regraft using a stem cell therapy approach to successfully regenerate the bone in oral facial trauma cases. In the future, Dr. Kaigler's lab is looking to develop more personalized scaffolds to fit the morphology of patient-specific bone defects.



**So, what are the limitations of science?** Kaigler quoted Arthur C. Clarke: "The only way to discover the limits of the possible is to go beyond them into the impossible." The limitations of science and discovery are beyond our imagination. We have to think outside of the box to take these technologies into the next level.

Above: Dr. Kaigler shares some imaginative inventions that changed our world and suggests a possible timeline for a bioengineered tooth.

# Award Recipients

## **John C. Greene Society Mentor of the Year Award:**

Dr. Misun Kang

## **ADCFP and Educational Research Category:**

### **1st Place: Marvin Chen (Mentor: Dr. Cristin Kearns)**

2nd Place: Angelina Tong (Mentor: Dr. Ram Vaderhobli)

### **Winner: Research Associate Category**

Miranda Werts (Mentor: Dr. Benjamin Chaffee)

### **Winner: Postdoctoral/Resident Category**

Jinsook Suh, PhD (Mentor: Christine Hong)

### **Winner: Graduate Category**

Jessi Cook (Mentor: Dr. Ophir Klein)

## **1st Place: Ernst Newbrun Award for Research Excellence**

Erin Welter (Mentor: Dr. Benjamin Chaffee)

## **2nd Place Predoctoral Category**

Eric Coy (Mentor: Dr. Stuart Gansky)

## **3rd Place Predoctoral Category**

Wesley Kao (Mentor: Dr. Stefan Habelitz)

## **People's Choice Award**

Tie: Eric Coy (Mentor: Dr. Stuart Gansky)

Amanda Gramacy (Mentor: Dr. Cristin Kearns)

## **Finalists for the PreDoc Category:**

Eric Coy (Mentor: Dr. Stuart Gansky)

Max Feinberg (Mentor: Dr. Jeffrey Bush)

Tiffany Huang (Mentor: Dr. Rich Schneider)

Wesley Kao (Mentor: Dr. Stefan Habelitz)

Szu Yu (Allie) Liu (Mentor: Dr. Diane Barber)

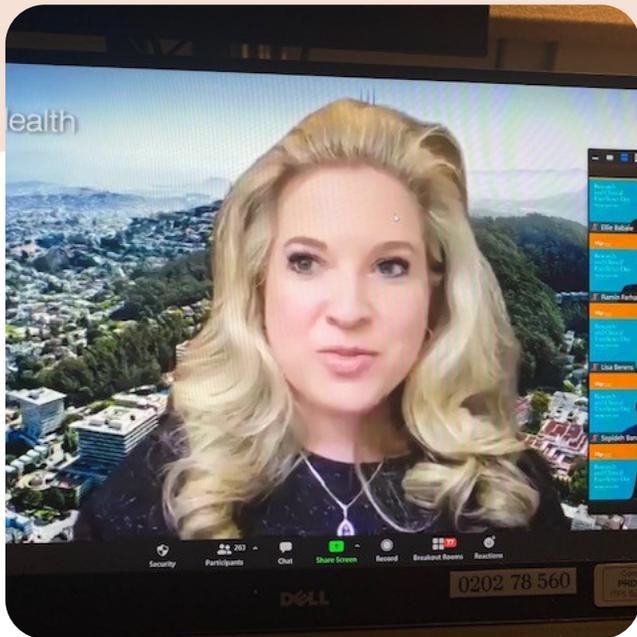
Jay Park (Mentor: Dr. Tamara Alliston)

Erin Welter (Mentor: Dr. Benjamin Chaffee)

Yan Zhang (Mentor: Dr. Christine Hong)



# RCED Presentations



**Oral Health: A Content Analysis**

UCSF School of Dentistry

**OBJECTIVES**  
This study was to identify oral health messages promoted by AFBC and its members on their websites and determine how messages were disseminated.

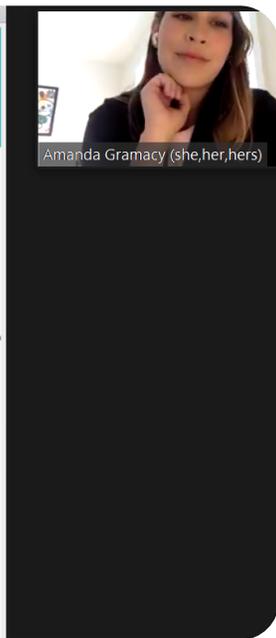
**METHODS**  
Websites of AFBC and its members were identified using a "Google site search" with terms: "dental", "oral", "caries", "teeth", "fluoride", "tooth decay", and "toothbrush". Websites were subsequently screened for relevance. Themes and dissemination methods were organized into themes.

**Identified Oral Health Messages (N=89)**

- Strengths (n=8)
- Opportunities (n=9)
- Threats (n=72)

**Categorized Threat Related Messages into Themes**

- Causation** (n=27)
  - Casting doubt on causes of tooth decay (n=27)
- Solution** (n=19)
  - Promoting non-dietary solutions for caries (n=19)
- Corporate Social Responsibility** (n=13)
  - Promoting corporate social responsibility (n=13)
- Discrimination** (n=7)
  - Questioning the singling out of sugary beverages for policy action (n=7)
- Promotion** (n=7)
  - Promoting oral health products (n=7)



Results 2021:

Research and Clinical Excellence Day

**Table 7-8. Research affiliation with Precision Health (PH) and Familiarity with HTE (Q#6-7 from Survey)**

Research Aligned with Precision Health (PH)	Responses N=41	Percentages
Yes	11	27%
No	28	68%
Decline to respond	2	5%

Familiar with HTE	Responses N=53	Percentages
Yes	25	47%
No	27	51%
Decline to state	1	2%

**Figure 1. Q#14: What are major challenges in conducting heterogeneity of treatment effect evaluation/subgroup analysis (from your experience)? Select all that apply.**

**Conclusion**

Genetics in Mouse Models of Human Disease

Dr. Jeffrey Bush, UCSF San Francisco

Research and Clinical Excellence Day

**Summary and Conclusions**

- Ephrin-B1 expression was extracted out in a three-dimensional view for palate landmark quantification.
- Comparison of controls and mutants revealed a trend of smaller palatal shelf area in heterozygous mutants. Further analysis suggests that this difference is due to size variations in the anterior and middle regions of the palatal shelves, and not the posterior.
- Overall, the methods tested proved to be fruitful and increased the appeal to investigate other genes in a three-dimensional view in studying palatogenesis.

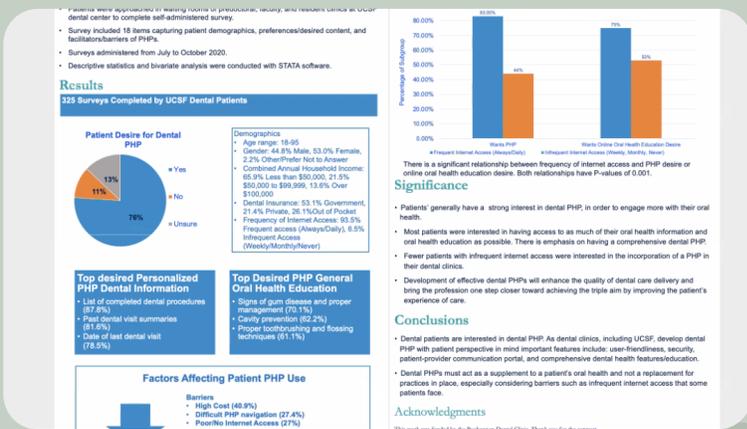
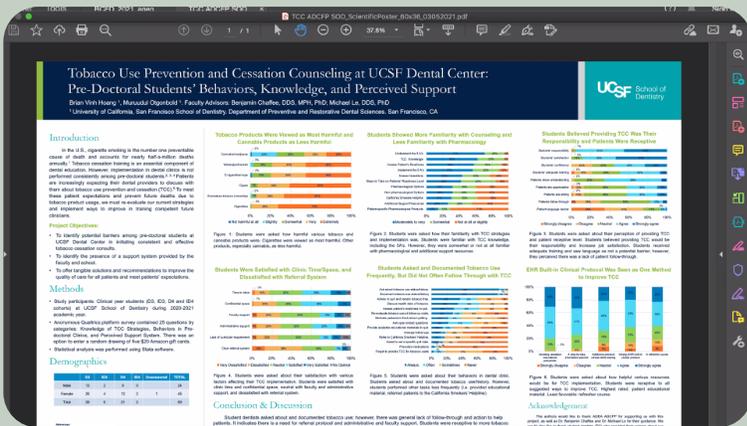
**Future Directions**

- Extend the current investigation by increasing the number of specimens and by measuring the palatal shelf volume in addition to area.
- Apply these three-dimensional segmentations to correlate the amount and location of Ephrin-B1 expression with shape change of the palatal shelf.
- Compare heterozygous and hemizygous samples by measuring the variability amongst anterior, middle, and posterior regions.
- Apply this methodology to other protein expression patterns.

**Acknowledgements**

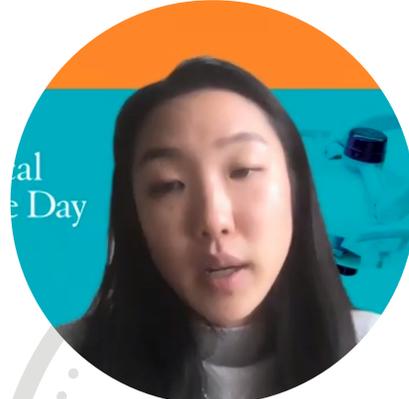
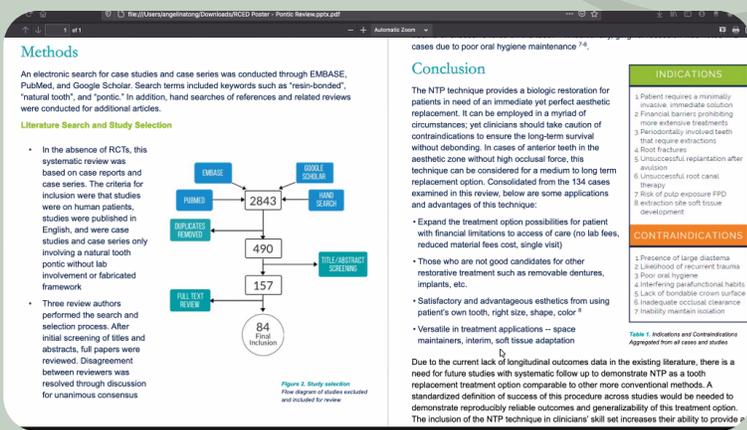
This project is supported by the UCSF Department of Cell and Tissue Biology.

Top left, Dr. Julie Sneddon introduces the 3-minute oral presentation speakers. Amanda Gramacy '23 (bottom left), Stephanie Ellman '23 (top right), and Max Feinberg '23 (bottom right) present their research projects.



**Respondent Characteristics (N=59)**

Class Year	Percentage	Gender	Percentage
IDP3/IDP4	10%	Female	65%
D1	51%	Male	27%
D2	24%	Not answered	8%
D3	10%	<b>Race/Ethnicity</b>	
D4	5%	Asian	65%
		White	15%
		Other	19%



Top to bottom: Muuduu Otgonbold '23 and Semira Amirkiai '23 present their research projects during the virtual poster session. Academic Careers Fellowship Program (ADCFP) fellows Saba Dolatshahi '22 and Angalina Tong '22 share their projects on dental education.

# 2020 SUMMER DENTAL STUDENT RESEARCH FELLOWSHIP PROGRAM



**Semira Amirkiai** (OBADAN-UDOH) Dental Patients' Perceptions and Desired Content from Patient Health Portals

**Jamie Chang** (B LIN, KS HOEFT) Role of California School Nurses in Addressing Children's Oral Health

**Jung A Choi** (H. RICHBOURG, R MARCUCIO) Effect of PP2A Activity on the Severity of Craniofacial Birth Defect Phenotype

**Eric Coy** (W SANTO, B JUE, H LINDAU, F RAMOS-GOMEZ, S GANSKY) Automated Gradient-Boosting Models Accurately Score Intraoral Plaque in Non-Standardized Images

**Stephanie Ellman** (AA LAZAR) Knowledge and Attitudes of Dental Researchers: A Precision Health Survey 2021

**Max Feinberg** (S MINCER, M O'NEILL, C TENG, C PERCIVAL, J BUSH)

Working Toward a Three-Dimensional Method to Study Secondary Palate Defects in Mouse Models of Human

**Joy Geng** (M BACINO, A RADAIC, P KAMARAJAN, Y KAPILA) Nisin Inhibits Oral, Colon, and Thyroid Cancer Cells In Vitro

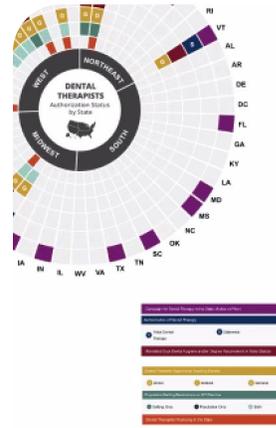
**Amanda Gramacy** (CE KEARNS) Industry Messaging about Sugar and Oral Health: A Content Analysis of Food Company Websites

**Michael Holland** (A KOTTEK, M WERTS, E MERTZ) Implementation of Dental Therapy Education in the United States

**Tiffany Huang** (SS SMITH, D CHU, RA SCHNEIDER) Runx2 Isoforms Differentially Regulate Mmp13 Promoter Activity

**Nicole Iribarren** (TK LIN, Z ARRIOLA, H LINDAU, F RAMOS-GOMEZ, SA GANSKY) Caries Quality-Adjusted Life Year Proxy for WIC Participants (TK LIN, Z ARRIOLA, H LINDAU, F RAMOS-GOMEZ, SA GANSKY)

**Haeyoon Jung** (HENNEFARTH, P USTRIYANA, M KANG, R WHITE, S SRIRANGAPATANAM, T LUE, M STOLLER, A SHINDEL, G LIN, S HO) Biomineralization of human penile tissue with phenotypic resemblance to bone



**on**  
 cessfully implemented dental therapy training programs  
 solutions compatible with existing state and federal  
 sed outcomes and reasons for implementing this new  
 ngst states, champions for dental therapy shared similar  
 rvention.  
**Change**  
 ites looking to implement dental therapy often cited a  
 ealthcare in rural communities contributing to an "oral  
 y by states to shift the model of oral healthcare to a focus  
 n than restoration  
 w education programs could develop providers who  
 communities

Advanced Dental Hygiene Practitioner which provided a home for education in existing programs

**Engagement by Key Stakeholders**

Champions of dental therapy largely shared the same beliefs about what the intervention could accomplish for oral health in the US. Many of these stakeholders mentioned a focus on prevention, health equity and goals of increasing access, and minority representation in healthcare leading to providers who reflect their communities.

**Conclusions**

- Iltisgaivik College's success in becoming the first education program accredited through CODA establishes one model for the development of dental therapy education programs
- Education programs that link dental therapy to existing dental hygiene programs are finding tensions between complying with CODA standards and state legislative mandates
- Future success for both DT and Dental Hygiene-Therapy education programs may rely not only on meeting CODA standards, but also on interstate collaboration for broader professional mobility and standardization

**References**

1. Institute of Medicine, National Research Council. Improving Access to Oral Health Care for Vulnerable and Underserved Populations. Available at: [nap.edu/catalog/13116/improving-access-to-oral-health-care-for-vulnerable-and-underserved-populations](http://nap.edu/catalog/13116/improving-access-to-oral-health-care-for-vulnerable-and-underserved-populations). Accessed November 8, 2020.
2. Nash DA, Friedman JW, Kardos TB, et al. Dental therapists: a global perspective. *Int Dent J*. 2008;58:61-70.
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Above, Michael Holland '23 presents his poster entitled *Implementation of Dental Therapy Education in the United States*

**Wesley Kao** (Y BAI, K LU, S HABELITZ) Evolutionary Developmental Analysis of Enamel Microstructure in Relation to Amelogenin Self-Assembly Domain

**Tiffany La** (KS HOEFT, A KOTTEK, C FOERTSCH, K SIMMONS, J WHITE, EA MERTZ) Dental Providers See the Value of Evidence-Based Dentistry: A Bumpy Road

**Alexander Le** (H KAVALI, AA LAZAR) UCSF Dental Clinic Patient Experience with Vulnerabilities During COVID-19

**Allison Liu** (C KOUGENTAKIS, F ALOISIO, N MEYER, D BARBER) Generating a Model to Study Lysosome pH Dynamics in Stem Cell Differentiation

**Discussion**

- Implementation was aided by:
  - An alignment of providers and WDG
  - Quality of care and financial incentives
- Providers saw value in the PD
  - Preventive measures
  - More proactive approach to patient care as patients are more involved with their own health outcomes
  - Standardized care across the organization
- Providers' main concern with the implementation of the model is the inflexibility of the CDS built into Axium.
  - Can put patients into boxes, despite an appeal process.
- Limitations: WDG is a unique organization and this model may not work in all settings.

**Conclusion**

- Dental providers at WDG welcome the use of the evidence-based dentistry and see it as the future of a more calibrated approach to dentistry.
- Future direction: Making CDS more user-friendly and introducing more flexibility into the system may improve providers' willingness to work with the PDCC model.

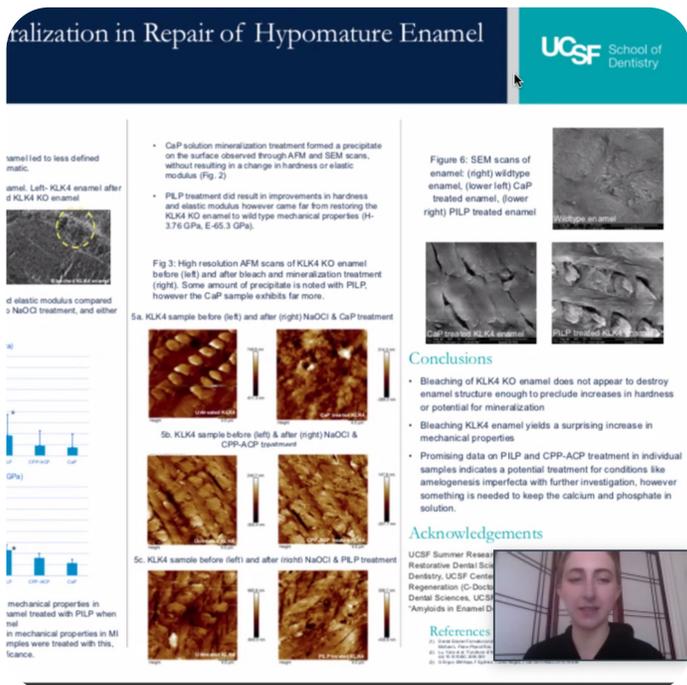
**Acknowledgements**

- Made possible by NIMHD/NIH R01 MD013719 and Delta Dental.

Above, Tiffany La '23 presents her poster entitled *Dental Providers See the Value of Evidence-Based Dentistry: A Bumpy Road*



Above, Marrina Ran '23 presents her poster entitled *Assessing Facial Aesthetics Using in Silico Generated 3D Models*



Above, Helena Viets '23 presents her poster entitled *Exploration of Bleaching with Remineralization in Repair of Hypomature Enamel School of Dentistry Research and Clinical*

**Viviane Nguyen** (S HABELITZ, E BABAIE, T LE)  
 Polymer-Induced Liquid Precursor (PILP)  
 Promotes Remineralization of Natural and  
 Artificial Root Caries Lesions

**Jay Park** (C SCHURMAN, N SZETO, T ALLISTON)  
 Osteocyte Cellular Network and Sclerostin  
 Expression in Aged Mouse Mandible School of  
 Dentistry Research and Clinical Excellence Day  
 2021 Program

**Marrina Ran** (NM YOUNG, S OBEROI) Assessing  
 Facial Aesthetics Using in Silico Generated 3D  
 Models

Amanda Rosenfeld (W MAYER, S TUGIZOV) HIV-  
 Associated Invasion of Oral and Cervical Epithelial  
 Cancer Cells

**Shreya Shah** Community Engagement is an  
 Integral Part of Dental Therapy Advocacy (S SHAH,  
 L BERENS, M WERTS, A KOTTEK, E MERTZ)

**Helena Viets** (Y BAI, K LU, E BABAIE, Y ZHANG, W  
 LI, S HABELITZ) Exploration of Bleaching with  
 Remineralization in Repair of Hypomature Enamel

**Erin Welter** (BW CHAFFEE) Dental Sealant  
 Utilization Patterns Among California Medicaid-  
 Eligible Children

**Christine Yoon** (Y ZHANG) Understanding the  
 Molecular Mechanism Responsible for Enamel  
 Defect in Nckx4-null Mice

**Yan Zhang** (J SUH, L ZHAO, N HWANG, G PAVLOS,  
 AJ CHEN, J CHAU, A RAO, N SABER, RH KIM, C  
 HONG) Mandibular and Cranium Skeleton  
 Malformation of CD271-null Mice

**Emily Zhao** (E CHENG, H LONG, J CHENG)  
 Development and Evaluation of an Oral Health  
 Mobile Application

# MEET ERIC COY



Eric Coy '23 conducted research on the development of machine-learning software that automatically scores intraoral plaque.

## Could you tell us a bit about your research?

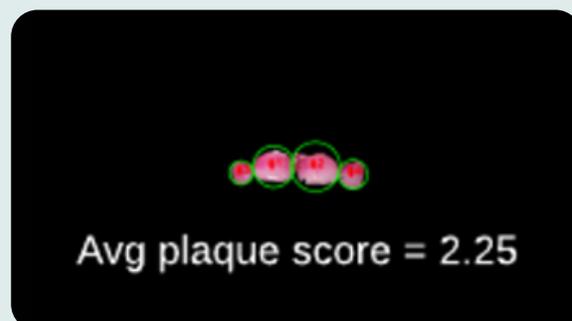
My research is about developing an automated plaque scoring software program. Our study evaluates whether the novel use of machine learning will more accurately score plaque that previously used statistical classification methods. I chose this project because my prior understanding of software engineering allowed me to hit the ground running and I thought that it was something that I would really enjoy.

## What did you enjoy the most about working on it?

I really enjoyed building and creating something that's my "baby." I'm making something that I can call my own and it's nice to see it working and come to fruition. The most satisfying part is when you're able to approach a problem, figure out how to solve it, get over the speed bumps and hurdles, and then see it all function! There were times when things didn't work, and that's okay, but troubleshooting and putting in the effort to see it work was so satisfying.

## Where do you see your research in the future?

There are three potential applications for automatic plaque scoring. We want to find a way to modernize dentistry that is appropriate for the times, especially in the age of Covid and remote appointments. A lot of people are moving towards remote monitoring of your patients' hygiene practices. Plaque scoring software can potentially be implemented into a teledentistry app where patients can take a picture of their plaque-disclosed teeth, and a report can be sent to the dentist, who can then compare it to past plaque scores and make assessments of areas of improvement. A personalized report can be sent to the patient too, without much user input from the dentist, that can hopefully give the patient tips and tricks to improve. That's the future direction, as far as teledentistry. Right now, the program is able to score plaque when you input the photos of plaque-disclosed teeth. As for clinical



Above, the images show how computer vision allows the program to identify contours that comprise our regions of interest, and further segmentation leads to scoring plaque at the single-tooth level.

applications, the program could also be integrated into an EHR system. When we're doing a prophylaxis with OHI, instead of manually going through every tooth and putting in a plaque assessment number for each tooth, we can take a quick picture, upload it to the EHR, and have it automatically done. Over time, this will be better for the practice and for the patients by allowing us to put more patients in the chair who might need more complicated procedures.

As for the research implications, this can eliminate the inherent subjectivity of scoring plaque on teeth for research studies. This program could allow us to score hundreds or thousands of photos in an instant and generate data that show general trends over a population more efficiently and more accurately. Also, the program could also be used when testing the efficacy of a hygiene product. For many of these studies, plaque scores are the primary outcome measure.



### What are your next steps?

So far I have implemented quite a few machine learning models onto this program, so I can pick out which has the quickest training time. There are some more advanced learning models that use deep learning, where you can generate synthetic data based on other data that you feed it. With deep learning, I would be able to generate more data to strengthen my models. Your machine learned models are only as good as the data you feed it. In the future, I plan to work with the UCSF IT program to get the deep learning environment set up appropriately. I also hope to work with an app developer who has a teledentistry app so I could incorporate my plaque scoring software program into a teledentistry app.

### Last thoughts?

Dr. Gansky is an incredible mentor. His insight and guidance has been incredible and I've really enjoyed my time with him, whether it's talking about my project or life. I find it very fortunate to have found someone that I get along with so well, and that's something that I would encourage other people to do as well--not just find a project that you're passionate about, but also to find a mentor that you are confident can lead you in a good direction and whom you'll enjoy your time with.

# 2020-2021 UCSF JGS Board Members

JOHN C. GREENE SOCIETY

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## Special thanks to...

Lisa Berens, DDS, MPH  
Roger Mraz



## Newsletter Editor Notes

It seems incredible to look back a year ago, when the confusion of the pandemic cast confusion and uncertainty over the course of the 2020 Summer Research Fellowship Program and R&C day. It even cancelled our spring newsletter!

And so, it feels like a special sort of triumph to publish this one--a showcase of the dedication, grit, and determination of everyone who had a hand in making this year's Research and Clinical Excellence day such a success. We're so proud to show you the incredible research and innovation that has continued despite the odds.

As Drake said, "Started from the bottom, now we're here." Looking forward to seeing you in our next (and last!) newsletter.

Sincerely,  
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