JARVIE

THE JOURNAL OF THE WILLIAM JARVIE RESEARCH SOCIETY

Volume 68
Spring 2025

COLUMBIA | COLLEGE OF DENTAL MEDICINE

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Volume 68
Spring 2025

Birnberg Research Program
Wednesday, April 2nd, 2025

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Columbia University, College of Dental Medicine
630 W. 168th Street, New York, NY 10032

"When apparently we have reached the limits of possibility, new avenues of progress and advancement are opened to our view and advances which shall make our knowledge of today seem in the light of the future to be but the densest ignorance."

– William Jarvie, 1905

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COLUMBIA | COLLEGE OF DENTAL MEDICINE

March 26, 2025

Dear Members of the Jarvie Society,

I am delighted to congratulate you on your research accomplishments. The College of Dental Medicine has a longstanding tradition of offering faculty-mentored clinical and basic science research opportunities for students to enrich their education and participate in the creation of new knowledge. I am pleased to welcome you into the ranks of researchers who look for ways to improve lives.

Participation in the William Jarvie Society is one of the most important traditions at CDM and the original research contained in this journal is a testament to the curious minds and keen intellects that are a hallmark of CDM students. I hope that your experience has enhanced your understanding of our field and that your newfound understanding will encourage you to continue to pursue answers that contribute to advancements in oral health.

Research training during dental school provides an appreciation for the process of discovery and sharpens the knowledge and skills needed to read and interpret new findings. Your experience will prepare you for careers as clinicians, in academic dentistry, and in research.

I look forward to your continued achievements and I salute the faculty mentors who have given you a leg up as researchers and oral health leaders.

Sincerely,

Dennis A. Mitchell, DDS, MPH
Interim Dean
Professor of Dental Medicine at CUMC
College of Dental Medicine

Columbia University College of Dental Medicine
630 West 168thStreet, New York, NY 10032

COLUMBIA

Office of Postdoctoral
and Residency Programs
College of Dental Medicine
Columbia University Irving Medical Center

April 2, 2025

Dear William Jarvie Research Society Members:

I want to take a moment to celebrate our unwavering commitment to research and scholarly activities. Our dedication to advancing knowledge and fostering innovation has never been more important, and it is truly inspiring to see the resilience and determination of our community.

I am delighted to say that within this great institution you remained true to our traditions and true to the College of Dental Medicine's mission reaffirming our commitment to scholarship, research, education, and patient care. I am equally delighted that the Student Summer Research Fellowship program remains strong amongst the Columbia student body as evidence by the mix of basic research and clinical studies.

To our students, I want to express my heartfelt support. Your passion for learning and your ability to adapt to new circumstances are commendable. We are here to support you every step of the way, ensuring that you have the resources and guidance needed to thrive in your academic and research pursuits. Research and scholarship are at the core of Columbia University values. The student publication and presentation of their research on Birnberg Day, are part of the CDM's mission of producing leaders in the field of oral health care.

Let us continue to uphold the values of excellence and integrity that define our institution. Together, we will overcome these challenges and emerge stronger, with a renewed sense of purpose and achievement. Thank you for your dedication and commitment. I look forward to celebrating our future successes with you.

Congratulations to all participating in Birnberg Research Day!

Sincerely,

James B. Fine, DMD
Senior Associate Dean, Postdoctoral Academic & Student Affairs

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March 25, 2025

Dear Members of the Jarvie Society,

It is with immense pleasure that I extend my warmest welcome to each and every one of you to the 68th Birnberg Research Day. This annual event stands as a testament to your dedication, hard work, and intellectual prowess, marking a significant milestone in your academic journey.

I am genuinely impressed by your unwavering commitment to advancing knowledge and your invaluable contributions to multidisciplinary dental research. I have no doubt that your endeavors will continue to make a profound impact on the field of dentistry.

As you prepare for this auspicious occasion, I urge each of you to seize the opportunity to learn from one another, to share your ideas and insights, and to engage in vibrant discussions that push the boundaries of knowledge into new and exciting realms. The chance to interact with fellow members of the CDM and CUIMC research communities on Birnberg Day will undoubtedly prove to be a rewarding experience, providing you with invaluable preparation for presenting your research findings at local, regional, national, and even international dental meetings.

A cornerstone of student research at CDM is the unwavering support provided by our esteemed faculty mentors. As evidenced by the wide array of research topics presented on Birnberg Day, our faculty members are actively engaged in various research domains, spanning from basic biomedical science to translational and clinical research, health policy, and health services research. Let us take a moment to express our gratitude to all faculty mentors for their exceptional leadership, mentorship, and steadfast commitment to supporting students and advancing knowledge within their respective areas of expertise.

Once again, I extend a warm welcome to the 68th Birnberg Research Day. I wish you all the very best, and I eagerly anticipate witnessing the outstanding research work being presented by our esteemed students.

Sincerely,

Chang H. Lee, PhD
Director of Research
College of Dental Medicine
Columbia University
chl2109@cumc.columbia.edu

Columbia University Medical Center

A message from the

President and Vice President

of the William Jarvie Research Society

Dear Members of the Columbia University College of Dental Medicine,

It is our great pleasure to present this year's edition of the Journal of the William Jarvie Research Society, highlighting the outstanding research achievements of our student body and faculty mentors. As the official student research organization representing Columbia University within the American Association of Dental, Oral, and Craniofacial Research (AADOCR) and the National Student Research Group (NSRG), the William Jarvie Research Society (WJRS) remains dedicated to promoting academic excellence and scientific discovery within the dental profession.

The journal showcases a diverse range of research abstracts that reflect the wide-ranging interests and expertise within our community—from public health and digital innovation to biomedical science and wet lab investigations. These projects will be presented at our annual Birnberg Research Symposium, a longstanding tradition at Columbia University that highlights the spirit of scholarly collaboration. The symposium features participation from both predoctoral and postdoctoral presenters, offering a unique opportunity for students and faculty across disciplines to come together in celebration of scientific advancement and a shared commitment to evidence-based dentistry.

At CDM, research is a core element of our education. The Summer Research Fellowship, offered to first-year students, plays a key role in fostering early engagement in scholarly work and nurturing a lifelong passion for discovery. To support our students, WJRS hosted several initiatives this year, including an information session on the Summer Research Fellowship, a CV Workshop led by Dr. Lynn Tepper, and events focused on finding mentors and navigating the research landscape at Columbia. These efforts are designed to equip students with the tools, resources, and mentorship needed to succeed in their academic and research pursuits.

We remain committed to supporting our students as they pursue research excellence and drive innovation in dentistry beyond the walls of Columbia. Our CDM researchers proudly contribute to the broader scientific community, representing the school at prestigious events such as the Greater New York Dental Meeting, the AADOCR Annual Meeting & Exhibition, the Hinman Student Research Symposium, and the AADOCR/NIDCR Advocacy Day in Washington, D.C.

Our heartfelt thanks go to the editorial team behind this year's journal and newsletter: Editor-in-Chief Nicole Lin, and Assistant Editors Jessica Chen, Ann Hoang, and Evan Stipano. We also want to recognize our tireless executive board: Yashica Kagipathu, Lauren Monette, Marina Portuondo, Kayla Thomsen, Brianna Margulis, Maya Jeremias, Parina Bhuva, Harsh Chheda, and Anna Jonczyk. We could not have achieved what we have this year without them. As always, we are especially thankful to our faculty advisor, Dr. Chang Lee, whose mentorship remains invaluable to all that we do.

It has been an honor to serve as President and Vice President of the William Jarvie Research Society. We are incredibly proud of all that our community has accomplished this year, and we look forward to the continued success and contributions of our members in the months ahead.

With gratitude,

Neeve Chen and Alexander Kim
WJRS President & Vice President
Class of 2026

History of the William Jarvie Research Society

The William Jarvie Society for Dental Research was organized on December 16, 1920. At the invitation of Dr. William J. Gies, all the undergraduate students of dentistry at Columbia University conferred with him for the purpose of considering the desirability of organizing a society of students, teachers, and benefactors for the promotion of the spirit of research in the School of Dentistry.

After general discussion, it was unanimously voted to proceed with the proposed organization and Joseph Schroff, MD** was elected temporary chairman. Because of the important relation which Dr. William Jarvie bore to the establishment of the School of Dentistry, and because of high interest in the promotion of dental research, it was unanimously voted that the society be named the William Jarvie Society for Dental Research and that Dr. William Jarvie be elected an honorary member. Dr. Schroff served ably as president during 1922. Dr. Monasch officiated during 1923, and in 1924, because of the amalgamation of the College of Dental and Oral Surgery with the School of Dentistry of Columbia University, interest in the organization diminished and the society ceased its activities in 1925. On February 7, 1929, the society resumed activity and elected officers. Interest revived, and the organization was again brought into prominent place in the extracurricular life of the school.

During 1932-33, several members of the faculty who had contributed greatly to research in dentistry and allied fields addressed the members of the society and their guests. Dr. Charles C. Bodecker, Professor of Oral Histology and Embryology, spoke on “Dental Caries and Allied Subjects” and illustrated his talk with a liberal number of lantern slides. Dr. Bodecker spoke of the various theories and the classification of dental caries and also explained the caries index for recording the extent of caries. He also briefly outlined the work done by various investigators in this field.

Dr. Byron Stookey, Associate Professor of Neurological Surgery, addressed the next open meeting, which was held as a feature of the alumni day activities. His topic was, “The Interpretation and Treatment of Painful Affections of the Trigeminal Nerve.” In a most interesting and instructive lecture, Dr. Stookey showed the relationship of diseases of this nerve to dental diagnosis. He explained the past work done in this field and the newer methods of surgical treatment, illustrating his talk with many lantern slides. He also presented several patients to demonstrate the effectiveness of his surgical treatment of this disease.

The Jarvie Society recorded another year of activity and accomplishment. Student interest in the organization was never greater, and a long and vigorous future for the society seems assured. The future of dentistry lies in its research into the problems that beset it, and the Jarvie Society has done its share in stimulating interest in this long-neglected phase of our work.

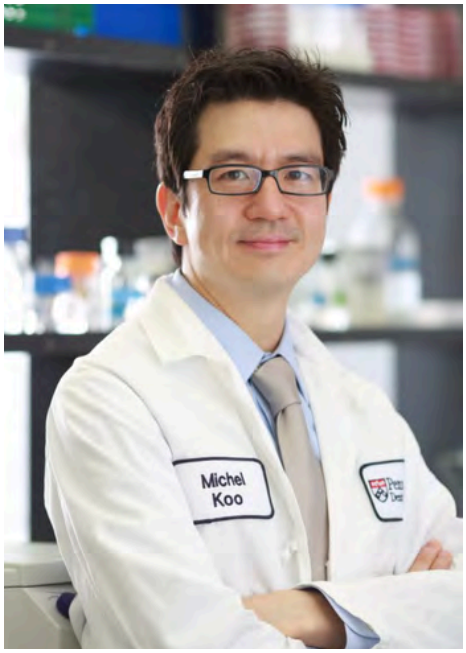
**An excerpt from the Dental Columbian, 1933.*
***Editor’s Note: Dr. Joseph Schroff, MD, one of the first two students admitted to the dental school through the Columbia admissions process, became the first student to receive the Columbia DDS degree in 1922. Dr. Schroff subsequently joined the SDOS faculty, teaching Oral Surgery to generations of students until his retirement as head of Oral and Maxillofacial Surgery in the early 1950s.*

Birnberg Research Award

The Birnberg Research Medal Award of the Dental Alumni of Columbia University was established by the Alumni Association of the Columbia University School of Dental and Oral Surgery in the early 1950s to encourage dental research of excellence and to help stimulate public interest in support of dental research. The award is named in honor of Dr. Frederick Birnberg (1893-1968), class of 1915, who helped to establish a research fund. The College of Dental Medicine faculty research committee, in conjunction with the school's Alumni Association, considers individuals who have made important contributions to dentistry through both research and mentoring for selection as Birnberg Lecturer and recipient of the Birnberg Research Medal Award of the Dental Alumni of CU. Sixty-four outstanding scientists and teachers have been honored as the Birnberg Lecturer since the first Birnberg Research Medal Award was presented in 1954.

Birnberg Lecturer and Award Recipients

1954 DR. CHARLES F. BODECKER
1955 DR. JOSEPH APPLETON
1956 DR. ISAAC SCHOUR
1957 DR. RALPH PHILLIPS
1958 DR. REIDER F. SOQNNAES
1959 DR. JOHN KNUSTON
1960 DR. MAXWELL KARSHAN
1961 DR. GEORGE PAFFENBARGER
1962 DR. ELI GOLDSMITH
1963 DR. EDWARD V. ZEGARELLI
1964 DR. FRANCIS A. ARNOLD
1965 DR. SEYMOUR KRESHOVER
1966 DR. PAUL GOLDHABER
1968 DR. SHOLOM PEARIMAN
1970 DR. MELVIN MOSS
1971 DR. IRWIN MANDEL
1973 DR. LESTER CHAN
1975 DR. RUSSELL ROSS
1976 DR. JEROME SCHWEITZER
1977 DR. GEORGE GREEN
1978 DR. DAVID SCOTT
1979 DR. BERGE HAMPAR
1981 DR. RONALD DUBNER
1982 DR. MARTIN A. TAUBMAN
1983 DR. LOUIS T. GROSSMAN
1984 DR. SOLON A. ELLISON
1985 DR. NORTON S. TAICHMAN
1986 DR. RONALD J. GIBBONS
1987 DR. ROBERT J. GORLIN
1988 DR. ENID A. NEIDLE
1989 DR. DAVID H. PASHLEY
1990 DR. WILLIAM H. BOWEN
1991 DR. HAROLD C. SLAVKIN
1992 DR. GEORGE R. MARTIN
1993 DR. RICHARD SKALAK
1994 DR. ZE'EV DAVIDOVITCH
1995 DR. IVAR MJOR
1996 DR. LORNE M. GOLUB
1997 DR. BRUCE J. BAUM
1998 DR. KENNETH ANUSAVICE
1999 DR. JAMES D. BADER
2000 DR. LARS HAMMERSTRÖM
2001 DR. DAVID T. W. WONG
2002 DR. HENNING BIRKEDAL-HANSEN
2003 DR. BARBARA DALE-BOYAN
2004 DR. PAUL B. ROBERTSON
2005 DR. BRUCE L. PIHLSTROM
2006 DR. JEFFREY D. HILLMAN
2007 DR. RALPH V. KATZ
2008 DR. ROBERT J. GENCO
2009 DR. DEBORAH GREENSPAN
2010 DR. SALLY J. MARSHALL
2011 DR. MICHAEL LONGAKER
2012 DR. R. BRUCE DONOFF
2013 DR. PETER J. POLVERINI
2014 DR. HENRY GINSBERG
2015 DR. LAURIE K. MCCAULEY
2016 DR. RENA D'SOUZA
2017 DR. GEORGE HRIPCSAK
2018 DR. JEANETTE M. WING
2019 DR. GORDANA VUNJAK-NOVAKOV
2020 DR. ANIL K. RUSTGI
2021 DR. ANIL K. RUSTGI
2022 DR. RITA CHARON
2023 DR. MUREDACH PATRICK REILLY
2024 DR. ERIC J. NESTLER
2025 DR. MICHEL (HYUN) KOO



2025 Birnberg Speaker and Research Awardee

Dr. Michel (Hyun) Koo DDS, PhD

Dr. Hyun (Michel) Koo, a dentist-scientist with expertise in food engineering, microbiology, and cell biology, is a professor in the Department of Orthodontics and the Divisions of Pediatric Dentistry and Community Oral Health at the University of Pennsylvania School of Dental Medicine, as well as a professor in the Department of Bioengineering at the School of Engineering and Applied Sciences. He co-founded and co-directs the Center for Innovation & Precision Dentistry (CiPD), a multidisciplinary institute advancing oral and craniofacial health through research, training, and entrepreneurship. He also directs an NIDCR T90R90 training program integrating dental medicine, engineering, and computational sciences to study disease mechanisms and develop innovative, accessible therapies.

Dr. Koo's laboratory investigates biofilms and their role in oral diseases, integrating engineering sciences to develop novel therapeutic and diagnostic approaches. His team utilizes multiscale imaging, biophysical, and computational techniques to study bacterial-fungal interactions and microbiome structures. His research has explored natural antimicrobials, nanotechnology-based antibiofilm solutions for caries prevention, and microrobots for automated plaque removal. His work is widely published in leading journals, including ACS Nano, Nature Communications, Science Robotics, PNAS, and J Dent Res.

A recognized leader in his field, Dr. Koo is an elected AAAS fellow and has received the IADR Distinguished Scientist and Innovation in Oral Care Awards. His work has been recognized by STAT as a finalist for Best Innovations in Science and Medicine and by Clarivate as a Highly Cited Researcher. Beyond his research, Dr. Koo is dedicated to mentoring the next generation of scientists and clinicians. Many of his graduate students and postdoctoral fellows have secured academic and industry positions worldwide. Through his commitment to scientific discovery, innovation, and education, Dr. Koo continues to make a lasting impact. The William Jarvie Society proudly recognizes him as the 2025 Birnberg Speaker and Research Awardee.

BIRNBERG RESEARCH PROGRAM

Schedule of Events for Wednesday, April 2nd

Faculty Club / 4th Fl., 630 W. 168th St. and Schaeffer Gallery / 1st Fl., 650 W. 168th St.

Birnberg Research Program Lecture

(Faculty Club / 4th Fl., 630 W. 168th St.)

12:00-1:00 PM **Exploring Biofilm Microbiomes: Integrating Biology, Engineering, and Dentistry**

Speaker and Birnberg Research Awardee:
Dr. Michel (Hyun) Koo, DDS, PhD
Co-Founding Direct of the Center for Innovation & Precision Dentistry
Professor in the Department of Orthodontics and the Division of Pediatric Dentistry at the University of Pennsylvania
Professor in the Department of Bioengineering at the School of Engineering and Applied Sciences

Faculty & Student Luncheon

(Faculty Club / 4th Fl., 630 W. 168th St.)
1:00-2:00 PM

Student Table Clinic and Research Poster Session

(Schaeffer Gallery / 1st Fl., 650 W. 168th St.)

2:00-3:00 PM **Judging Session**

3:00-5:00 PM **Open Session to Public**

William Jarvie Society Members

2024-2025

Rania Ahmed
Jonathan Alterman
Kamilla Azbel
Lawrence Bossong
Odette Castillo
Sam Comito
Kayla Crowley
Luis Diaz
Joseph DiTaranto
Bingyi Dong
Leah Farhy
Nick Foehl
Dominic Forte
Jenisa Gandhi
Mekkhi Gardner
Matthew Gelin
Elizabeth Gershater
Michelle Ginsburg
Ryan Hwang
Daniel Ilyayev
Akasha Imtiaz
Samuel Jeon
Anna Jonczyk
Kathryn Jones
Yee Hyun Jun
Min Seo Kim
Vika Kartseva
Jasleen Kaur
Myrna Khalil
Min Jin Kim
Kang Young Kim
Poe Kim
Pooka Kolli
Saumya Kumaran
Rivka Lax
Subin Lee
Satvi Limbasia
Chathuni Liyanagae
Alexandria Lo
Dorothy Low
Jeyan Mahmoodi
Dave McNeill
Eisa Mohiuddin
Leana Nektalova
Justing Ng
Angelyn Nguyen
Christine Park
Riya Patel
David Pellei
Katelyn Phelps
Josh Rosenfeld
Mia Rouse
Maddie Salinas
Jack Schob
Leora Segal
Parisa Shahin
Jennifer Shamash
Maya Sharma
Amanda Shen
Brennan Speier
Chloe Stacks
Gabriella Trama
Ved Tripathi
Khan (Bi) Tran
Donna Vasseghi
Tanmayee Vegesna
Ruotong Wang
Ashley Wen
Garrett Wencel
Bella Wiener
Justin Wu
Eugene Yang
Matthew Yee
Claire (Ryeogyeoung) Yoon
Edward Yu

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Anna Jonczyk	*D1 Representative*

Predoctoral Abstracts

Molecular, Cellular, Tissue, System, Regenerative Medicine, Organism, Biology & Physiology

1. Accuracy of Digital vs Clinical Measurements of Keratinized Gingival Tissue Dimensions

Gursimran Grewal[1], Vishrutha Arun[1], Anthony Sulvetta[1], Dr. Karim El Kholy*[1]
[1] *Columbia University College of Dental Medicine, New York, New York*

Introduction: Keratinized tissue (KT) consists of lamina propria with thick collagen fibers, firmly attached to the underlying periosteum and alveolar bone. Studies suggest that a minimum amount of KT around teeth and implants is essential to resist gingival recession. However, measuring KT is often complicated due to challenges in visibility, the angle of measurement, and the type of probe used, leading to difficulties in standardizing measurements. Digital scanning has revolutionized the capture of intraoral anatomical information, quickly replacing traditional analog impression techniques. This advancement presents a unique opportunity to capture more precise gingival dimensions, significantly enhancing a clinician's ability to diagnose and monitor KT deficiencies.

Objectives: The primary aim of this study was to compare the accuracy of 3D digital measurements of KT obtained from 3D optical impressions with linear clinical measurements made using a periodontal probe. Additionally, the study aimed to assess inter-examiner variability, including a comparison of measurements made on the dominant vs. non-dominant side of the examiner.

Materials & Methods: Examiners were calibrated to measure KT width in human patients using a periodontal probe. Measurements (rounded to 0.5 mm) were taken from the mid-buccal surface of 127 teeth by two examiners, considering their handedness. Digital scans were obtained, and two calibrated clinicians measured KT width using 3Shape Viewer software. A paired, two-tailed t-test compared differences between methods and sides, while a coefficient was calculated to compare linear and 3D measurements.

Results and Conclusions: The results revealed a significant difference between manual and digital measurements. Clinicians using the periodontal probe showed notable inter-examiner variability, while 3D measurements from digital scans were more consistent with no such variability. Differences between measurements on the dominant vs. non-dominant side were found with the probe, but not with digital measurements. Additionally, 3D measurements were, on average, 1.04 times larger than linear measurements, suggesting both clinical and digital linear measurements may underestimate gingival dimensions. The study demonstrated that 3D digital measurements eliminate inter- and intra-examiner variability seen in clinical probing. A coefficient was also derived to improve the accuracy of linear measurements when applied to 3D representations.

Discussion: To the best of our knowledge, this study is the first to directly compare digital scanning and periodontal probing for measuring KT in humans. The findings have significant implications, potentially advancing the use of intraoral optical scanning combined with AI applications to extract more precise anatomical data. These innovations could significantly enhance diagnostic and treatment planning capabilities in periodontal care, offering a more reliable and standardized method for measuring KT dimensions.

2. Salivary and serologic EBV viral burden during acute and post-acute COVID-19: a cohort study

Jessica Y. Chen[1], Scott Lu[2,3], Sarah A. Goldberg[2,3], Thomas Dalhuisen[2,3], Jeffrey N. Martin[2], Timothy J. Henrich[4], Michael J. Peluso[5], J. Daniel Kelly*[2]

[1] Columbia University College of Dental Medicine, New York, New York, [2] Department of Epidemiology and Biostatistics, UCSF, [3] Institute of Global Health, [4] Division of Experimental Medicine, UCSF, [5] Division of HIV, Infectious Diseases, and Global Medicine, UCSF

Introduction: Epstein-Barr Virus (EBV) is a ubiquitous human herpes virus that infects an estimated 90% of the human population, and can reactivate from latent to active infection when stressors trigger the expression of viral lytic genes, leading to viral replication. COVID-19 is an inflammatory condition that can contribute to impaired cellular immunity and has been implicated as a trigger for changes in EBV DNA burden. The relationship between COVID infection and EBV viral burden is poorly understood.

Objectives: To describe prevalence of EBV DNA in the saliva and anti-EBV antibody responses during the acute phase of SARS-CoV-2 infection.

Materials & Methods: We enrolled a cohort of non-hospitalized COVID-19 cases within 5 days of their illness onset in the Bay Area, California. Participants self-collected saliva samples serially throughout the first 28 days of illness; blood was collected at their final visit on day 28. Saliva was analyzed for EBV DNA via PCR; blood was analyzed for early-D IgG and viral capsid IgM. Viral load was assessed for each participant to categorize trajectories into persistent vs. intermittent and high vs. low EBV DNA burden.

Results & Conclusions: Among the 59 COVID-infected individuals with EBV DNA data in the saliva over the 28-day period, 25 (42.4%) were undetectable, and 34 (57.6%) had detectable EBV DNA on at least 1 sample. We found 15 (44.1%) of 34 had high-level DNA; 11 (73.3%) of the 15 were persistently detectable while the other 4 were intermittently detectable. 15 (44.1%) of the 34 individuals had low-level DNA; 7 (46.7%) of 15 were persistently detectable while the other 8 were intermittently detectable. The remaining 4 (11.7%) had an isolated detectable event. The lack of evidence that saliva EBV DNA triggers day-28 antibody responses suggests other factors may explain post-acute EBV seropositivity.

Discussion: The majority of SARS-CoV-2 infected participants demonstrated detectable EBV DNA, though there was a large degree of variation within viral trajectories. There is no clear standard for diagnosing EBV reactivation. Furthermore, the coinfection of COVID-19 and EBV can make it difficult to discern the contribution of either condition to a patient's symptomatology.

3. Periodontal Ligament Regeneration with CRISPR Activation and Pluripotent Stem Cells

Harsh Chheda[1], Christopher L. Ricupero*[1], Chang H. Lee*[1]

[1] *Columbia University College of Dental Medicine, Center for Dental & Craniofacial Research, New York, New York*

Introduction: Periodontal disease affects over a billion people worldwide, leading to bone resorption and periodontal ligament loss, which presents major regenerative challenges. CRISPR activation (CRISPRa) offers a precise and scalable alternative to traditional gene therapy by enabling the simultaneous upregulation of multiple genes using guide RNAs. This study focuses on enhancing the expression of Scleraxis (SCX) and Mohawk (MKX), two transcription factors crucial for periodontal ligament regeneration, using CRISPRa in human induced pluripotent stem cells (iPSCs) combined with valproic acid (VPA) to enhance chromatin accessibility. By integrating multiplex gene activation with chromatin modulation, this approach offers a cost-effective and innovative strategy for periodontal regeneration.

Objectives: We hypothesize that epigenetic editing using CRISPR activation (CRISPRa), specifically targeting and multiplexing key tendon and periodontal ligament genes will stimulate periodontal ligament regeneration. By activating key transcription factors: Scleraxis (SCX) and Mohawk (MKX) we aim to extend our previous findings into human induced pluripotent stem cells (iPSCs). In addition, we build upon the use of valproic acid (VPA), which we hypothesize loosens chromatin, allowing for increased dCas9-VPR-MKX guide binding and activation.

Materials & Methods: CRISPRa plasmid DNA components were isolated from bacterial colonies grown on ampicillin plates and midiprepped. Human iPSCs were co-transfected via Lonza Nucleofection kit with dCas9-VPR and previously designed guide RNAs to upregulate SCX and MKX endogenous gene expression. RNA was extracted, converted to cDNA, and analyzed using qPCR. VPA was added 4 hours post-transfection. Data was analyzed using an unpaired t test for statistical significance ($P<0.05$).

Results & Conclusions: CRISPRa significantly upregulated MKX (10.6-fold) and SCX (146.7-fold) in human iPSCs compared to guide-only controls. Adding VPA further enhanced expression, with MKX + VPA increasing 38.1-fold and SCX + VPA reaching 586.9-fold. Multiplexing both genes resulted in lower expression (4.9-fold for MKX, 121.4-fold for SCX), but multiplex + VPA still achieved significant increases (18.4-fold for MKX, 424.0-fold for SCX). These findings highlight CRISPRa's potential for precise, scalable gene activation, with multiplexing and VPA offering a powerful approach to periodontal regeneration.

Discussion: Epigenetic modulation through CRISPRa was successfully optimized in human iPSCs for the upregulation of MKX and SCX, with VPA significantly enhancing gene expression. This approach presents a scalable, precise, and cost-effective alternative to traditional gene therapy, enabling simultaneous activation of multiple genes without permanent DNA modifications. These findings highlight CRISPRa's potential for periodontal regeneration, warranting further investigation into VPA's role and additional gene targets. Future studies will focus on in vivo validation and assessing functional and clinical outcomes.

Harsh Chheda was supported by a Summer Research Fellowship and Research Liaison.

4. Preliminary Assessment of Biphasic Polylactic Acid Biomaterials for Compatibility as Scaffolding in Guided Bone Regeneration

Nikolas Christoffel[1], Yu-Ting Li[2], Hao-Hueng Chang*[2]

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Introduction: Guided Bone Regeneration (GBR) is an oral surgical procedure with the purpose of increasing alveolar bone volume by the use of barrier membranes and scaffolding, often in preparation for osseointegrated implant placement or as treatment for peri-implant alveolar bone defects. 3D-printed biomaterials can act as structural scaffolds for bone to grow within. There are many types of biomaterials currently being investigated as scaffolds that may help improve the long-term success of GBR surgeries. Polylactic acid (PLA) can be made into filaments for 3D printing capability, which may allow scaffold construction. Some biphasic bioceramics, such as dicalcium phosphate / hydroxyapatite (DCP/HA), have been shown to promote bone regeneration in peri-implant defects. HA/PLA scaffolds have previously been applied to support dental pulpal stem cells in a study on tooth regeneration. The toxicity of biomaterials and ability to induce calcification can be tested by different assays; CCK-8 tests for cell viability, and ALP and ARS assays evaluate osteogenesis. In this study, HA/PLA was tested and compared to two other biphasic bioceramic materials for their compatibility for osteogenesis.

Objectives: The aim of this study was to test the compatibility of polylactic acid (PLA) filaments containing different bioceramics with mouse bone stem cells, MC3T3-E1 cell line. Assays for cell viability and osteogenesis were performed to determine if several different biphasic PLA biomaterials have toxicity and assess their ability to induce calcification in bone cells. Results of these preliminary tests inform us of their potential to be applied clinically as 3D scaffolding in GBR surgeries.

Materials & Methods: There was one control group that consisted of only MC3T3-E1 cells (for the CCK-8 assay) or MC3T3-E1 cells plus L-Ascorbic acid-2-phosphate (A) and β-Glycerophosphate (B) (for ALP and ARS assays). There were four experimental groups that each consisted of the MC3T3-E1 cells with A and B (for ALP and ARS assays), plus extract of one of the following biomaterials: polylactic acid (PLA), hydroxyapatite / polylactic acid (HA/PLA), β-tricalcium phosphate / polylactic acid (β-TCP/PLA), or hydroxyapatite and β-tricalcium phosphate / polylactic acid (HA+β-TCP/PLA). The three assays, CCK-8, ALP, and ARS, were planned to test each group and be performed in triplicate.

Results & Conclusions: Due to the short-term duration of this specific experiment attempt and premature loss of the cell lines, there were insufficient ALP results to report for Day 7, and the ARS assay was not able to be performed. This experiment must be attempted again to gather complete data on the differences in calcification potential between the PLA biomaterial groups, and draw conclusions.

Discussion: This experiment represents a preliminary in-vitro method to evaluate the toxicity of biomaterials and their osteogenic potential, and is merely a start to a process of sequential steps needed to bring new biomaterial candidates to clinical use. Following viability and osteogenesis assessments, the successful biomaterials may then be applied to living animal models, such as beagle dogs, in post-extraction sites of the mandible. If safe and effective in animal models, human clinical trials may begin. Another attempt is required to bring this preliminary experiment to completion and determine if biphasic PLA biomaterials show potential to be applied clinically as bone graft scaffolding. As new biomaterials are identified and different compositions of materials are attempted, the ultimate goal is to improve bone regenerative procedures and the success of GBR surgeries.

5. Probiotic Adhesion to Electrospun Fibrous Scaffolds as a Function of Fiber Diameter

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Introduction: Probiotics are microbes that have been shown to confer a health benefit to their host. Advancements in genetic engineering technology have allowed for significant control over various traits of microbes resulting in a broadening class of probiotics in medicine. In applying these treatments, a significant consideration is in delivery and localization. As such, the cellular behavior of probiotics in conjunction with a biomaterial system is paramount for effective function of applied probiotics. Electrospinning is a method of creating fibrous scaffolds able to influence cell attachment and growth; this is of interest in delivering probiotics.

Objectives: To evaluate the effect scaffold properties, specifically fiber diameter, has on the adhesion and growth behavior of probiotic bacterium *Lactococcus lactis*.

Materials & Methods: Nanofiber scaffolds were created utilizing a custom electrospinning setup. Scaffolds were fabricated with gelatin in 50% acetic acid at concentrations of 20%, 27.5%, and 40% w/v. *L. lactis* was grown overnight under aerobic conditions in BHI media. The culture was standardized to an OD_{600} of 0.3. Scaffolds were incubated and incubated at 37℃ for either 0.5, 2, 6, or 18 hours at a 1:100 dilution. The number of bacteria attached to scaffolds was evaluated via CFU assay (N=5). Scanning electron microscopy (N=2) was also performed to evaluate the morphology of scaffolds, cells, and biofilm production.

Results & Conclusions: Nanofibrous scaffolds were successfully fabricated at three statistically different fiber diameters. The diameter of the fibers correlated linearly to gelatin concentration. *L. lactis* attached more effectively to scaffolds with larger fiber diameters. This enhanced attachment resulted in increased cell growth on the 400 nm diameter scaffold from 6 hours of culture onwards. Additionally, greater infiltration of cells was seen in larger diameter scaffolds.

Discussion: The fiber diameter of the scaffolds proved to have a significant effect on the adhesion of the relevant probiotic, *L. lactis*. More specifically, with a fiber diameter of 200 nm, smaller than the *L. lactis* cell itself, there was significantly reduced attachment and growth. The 400 nm fiber diameter supported significant growth; this mechanism is still to be determined. It will be important to continue similar experiments in order to provide insight into the effect composition and morphology of nanofibers has on optimal adhesion and growth.

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6. Engineered 3D culture platforms reveal the pro-dysplastic contributions of cell intrinsic and extrinsic factors in Barrett's esophagus

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Introduction: Barrett's esophagus (BE) is a disease in which the squamous epithelium of the esophagus is replaced by a columnar intestinal epithelium (termed metaplasia), and is believed to affect 3-4 million people in the US. BE patients have a 30-125-fold greater risk of developing esophageal adenocarcinoma (EAC) via intermediate dysplastic states, when compared to the general population.The progression from BE to EAC involves both intrinsic genetic mutations, such as TP53 alterations, and extrinsic factors, including extracellular matrix (ECM) stiffening. The interplay between these factors may drive dysplastic changes, making it crucial to develop models that accurately replicate BE progression.

Objectives: This study aims to establish human induced pluripotent stem cell (hiPSC)-derived esophageal organotypic raft cultures and organoids harboring disease-relevant TP53 mutations. We seek to evaluate the interaction between TP53 mutations and ECM stiffness in promoting dysplasia within a hiPSC-derived model of intestinal metaplasia.

Materials & Methods: hiPSCs were differentiated into esophageal progenitor cells and incorporated into 3D Matrigel hydrogel cultures, either as organoids or stratified raft cultures. Some cultures included mesenchymal cells to better mimic in vivo conditions. ECM stiffness was modulated to reflect physiological and pathological environments. Characterization of differentiation and structural integrity was performed via immunofluorescence and histological staining.

Results & Conclusions: Preliminary findings show successful generation of 3D esophageal cultures with structural organization and differentiation patterns resembling BE progression. H&E staining revealed organized epithelial structures, supporting the feasibility of this model. Early observations suggest ECM composition influences cellular morphology and behavior, laying the foundation for further investigation into the combined effects of ECM stiffening and TP53 mutations. Future work will focus on modulating ECM stiffness and assessing its direct role in dysplastic transformation.

Discussion: Our results demonstrate that hiPSC-derived esophageal organoids and raft cultures can serve as a viable model for studying BE pathophysiology. The dynamic morphological changes observed over time highlight the potential role of ECM stiffness in disease progression. Further research will investigate the synergistic effects of TP53 mutations and ECM alterations, with the goal of identifying novel therapeutic targets for BE and EAC.

Roxana Garcia was supported by a Columbia College of Dental Medicine Summer Research Fellowship.

7. Oral Microbiome Differences Between Cleft Lip and/or Palate Patients and Unaffected Peers

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Introduction: Cleft lip and/or palate (CL/P) is one of the most prevalent congenital disorders. It has been previously posited that people with CL/P have a different oral microbiome compared to what is typical of unaffected individuals. Certain dental maladies that are associated with bacterial colonization and infection more severely affect CL/P patients. Thus, determining how the oral microbiome of an individual with CL/P may differ from what is typical would be useful in developing a more effective treatment approach to ensuring the health of people with CL/P.

Objectives: To identify specific species differences in the bacteria colonization of the oral environment between patients with cleft lip and/or palate and unaffected controls

Materials & Methods: An article search was conducted in PubMed using the keywords “cleft lip,” “cleft palate,” “biofilm,” “microbiome,” “bacteria,” “fungal,” and “microbiology.” Reviews, systematic reviews, meta-analyses, and papers that had non-human subjects or were not written in English were excluded. Data was organized by location in the oral environment and genus/species.

Results & Conclusions: 30 species of bacteria, 7 genera of bacteria and 1 genus of fungus were identified as being prone to CL/P. Higher levels of a particular genus and species (not simply their presence) were specifically associated with this condition. Other diseases were identified as being prone to the non-CL/P controls. Interestingly, some studies disagreed on the association of particular genera and/or species with CL/P, non-CL/P, or neither.

Discussion: Several of these species have been previously linked to dental conditions such as caries, oral soft tissue diseases like gingivitis and periodontitis, and endodontic infections. Other species have been associated with phenomena that cause or promote oral disease, such as production of acid or creation and development of biofilms. Additionally, many more groups of microbiota have been linked to other diseases that affect other areas of the body at the cellular, tissue, and organ levels.

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8. Characterizing B Cell Subsets in Immune-related Adverse Events of Sjögren's Patients

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Introduction: Primary Sjögren's Syndrome (SS) is an autoimmune disorder causing ocular and oral dryness due to inflammatory destruction of the lacrimal and parotid glands. Its pathogenesis involves B cell hyperreactivity and autoantibody production (anti-Ro/SSA, anti-La/SSB), leading to chronic inflammation and tissue damage. Some patients acquire SS through immune-related adverse events (ir-AEs) during cancer treatment via immune checkpoint inhibitors (ICIs), which target CTLA-4, PD-1, and PD-L1 to enhance CD8+ T cell activity against tumors. SS is a devastating oral ir-AE that often responds poorly to conventional therapies, with symptoms sometimes persisting even after ICI discontinuation.

Objectives: To assess the variation in the immunological sub-populations of B cells across healthy individuals, primary SS, and ir-AE SS patients.

Materials & Methods: The total patient population consisted of 1 healthy control, 1 ir-AE SS patient, and 4 primary SS patients. Blood samples were processed and stained with a color spectral flow cytometry panel that identified B cells using over 40 fluorochrome-conjugated antibodies. The fluorochrome color tags were analyzed using FCS Express to label and divided into different immune cell subsets based on fluorescence signals for identification.

Results & Conclusions: Naïve+ immature transitional B cells were notably increased in classic SS compared to healthy controls, with a marked rise in both transitional 1 and 2 subsets, while transitional 3 B cells showed a moderate decrease. The activated naïve subset was similarly elevated. In ir-AE associated SS, transitional 1 and 2 subsets exhibited comparable increases. A mild decrease in transitional 3 B cells was also observed, along with a similar increase in the activated naïve subset and pre–unclass-switched memory (marginal zone) B cells. Class-switched memory B cells were significantly reduced in classic SS, particularly in the major class-switched memory subset. This reduction was even more pronounced in ir-AE associated SS. Antibody-secreting plasmablasts were similarly decreased in both conditions. Unclass-switched memory (marginal zone) and double-negative memory B cell levels remained comparable across classic SS, ir-AE associated SS, and healthy controls.

Discussion: Classic SS exhibits two major B cell alterations: increased transitional and naïve B cells, especially in transitional 1 and 2, and reduced maturation to class-switched memory. The rise in transitional B cells suggests defective autoreactive B cell elimination, leading to their accumulation in peripheral blood. Comparable unclass-switched memory and double-negative memory levels indicate an additional defect in differentiation to IgD-negative, CD27+ memory B cells and plasmablasts. B cell development in ir-AE SS mirrors classic SS, suggesting a shared defect in autoreactive B cell elimination. Autoreactive B cells likely present self-antigens, driving autoreactive T cell expansion and glandular infiltration, causing SS symptoms.

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9. Investigating the neuropathophysiology of oral bacteria *Fusobacterium nucleatum* infection

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Introduction: *Fusobacterium nucleatum* is a gram-negative anaerobic oral bacterium. While typically commensal, it can become pathogenic, leading to systemic diseases such as periodontal bone loss, colorectal cancer, and pregnancy complications. *F. nucleatum* expresses FadA, a virulence factor that polymerizes into amyloid filaments and may contribute to neurodegenerative diseases, including β-amyloid-associated Alzheimer's. *F. nucleatum*'s FadA presence and ability to cross the placental barrier raises interest in its neurological impact.

Objectives: This study investigates *F. nucleatum*'s impact on brain development and cognition in transplacentally infected mice. Brain slices from infected and saline mice will be analyzed using immunohistochemistry (IHC) and immunofluorescence (IF) to determine *F. nucleatum* localization and inflammatory responses.

Materials & Methods: Parental mice were infected through tail vein, leading to transplacental infection in offspring exhibiting cognitive abnormalities. Resulting pups were placed for euthanasia in CO2 chambers for 5 minutes, and cervical dislocation was performed for secondary confirmation. After PBS washes, midline of the anterior skull was broken with forceps and scissors; the brain was removed from the meninges and placed onto a dry ice Petri dish. For IHC and IF, formalin-fixed, OCT-embedded tissue sections (5 µm) were dewaxed at 100 °C, rehydrated with xylene and alcohol washes, and given antigen retrieval in citrate buffer (pH 6.0) for 20 minutes. After cooling, slides were incubated in 3% hydrogen peroxide, blocked with 2.5% horse serum for 1 hour, and incubated overnight at 4 °C with primary antibody (*F. nucleatum* polyclonal rabbit serum, 1:2000). After PBS/PBST washes, secondary antibody (biotinylated goat anti-rabbit IgG, 1:500) was applied for 1 hour, followed by DAB substrate. Sections were counterstained with hematoxylin, washed, dehydrated with alcohol and xylene, mounted using Permount medium, and viewed via Irving Cancer Center Confocal Microscope.

Results & Conclusions: Immunohistochemical staining showed *Fusobacterium nucleatum* was detected in the *Fn*-infected pups' cortex and hippocampus. Neuronal presence was confirmed in both *Fn*-infected and saline mice. Immunofluorescent staining depicted presence of *Fn* and amyloid in *Fn*-infected mice only, while also showing co-localization of the two factors.

Discussion: Through the IHC and IF stainings, we can deduce that transplacental infection of *F. nucleatum* affects brain development and maturation. Future directions include performing FadA (amyloid precursor) IHC staining to determine presence of amyloid-filaments, while continuing transplacental *F. nucleatum* infection to confirm IHC imaging across multiple offspring, and quantifying data through ImageJ analyses.

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10. Meniscus Healing in Multi-tissue Crosstalk under Physiological Loading and Inflammation

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Introduction: The knee meniscus and the temporomandibular joint (TMJ) disc are both diarthrodial hinge joints with fibrocartilaginous tissue positioned between two articulating surfaces and are both associated with osteoarthritis. Given these similarities, research on the knee meniscus may offer valuable insights for TMJ studies. Notably, the avascular region of the meniscus has limited healing potential due to its lack of blood supply. In our study, we studied the effects of various factors on meniscus healing.

Objectives: The objectives of this study are to investigate the effects of multi-tissue interactions and physiological loading on avascular meniscus healing under inflammation.

Materials & Methods: An in-vitro joint model was established in a custom-designed multi-compartment PDMS mold, where tissue-engineered adipose tissue (eAT), bioprinted synovial membrane (syM), and meniscus explants undergo injury and healing. eAT was engineered in 3D-printed scaffolds delivered with adipose-derived stem/progenitor cells via collagen bioink, and syM was bioprinted in two layers of cell-laden gelatin methacryloyl bioink containing THP-1 cells-derived human macrophages and synovial mesenchymal stem/progenitor cells (syMSCs). A full-thickness longitudinal tear was created in the meniscus explant, repaired by fibrin-based bioactive glue, releasing CTGF and TGF-β3. The joint model was cultured for 4 weeks statically and 4 weeks under 10% physiological loading to the meniscus explant using our meniscus-specific bioreactor, with or without 10 ng/ml IL-1β stimulation ($n \geqq 12$ per group).

Results & Conclusions: IL-1β impaired meniscus healing, with greater severity in groups co-cultured with syM. However, co-culturing with eAT attenuated IL-1β's effects, reducing pro-inflammatory signals. Notably, adipokine reductions observed in meniscus-eAT co-cultures were less pronounced in all three tissue co-cultures, and IL-1β levels in media also decreased with eAT. Single-cell RNA sequencing (scRNA-seq) showed reduced differentiation and matrix formation genes and increased pro-inflammatory genes in syMSCs, while adipocytes showed upregulated anti-inflammatory genes with IL-1β. Delayed onset of physiological loading promoted meniscus healing despite IL-1β stimulation. Further analysis indicated that loaded fibrochondrocytes enhanced fibrochondrogenic signaling to syMSCs, while pro-inflammatory signals from syMSCs to macrophages decreased, and anti-inflammatory signals from adipocytes increased.

Discussion: Our findings suggest that multi-tissue crosstalk, inflammation, and mechanical loading influence meniscus healing. Specifically, fat promotes an anti-inflammatory environment, while syM drives a pro-inflammatory response. Additionally, physiological loading under inflammation supports MSC differentiation into fibrochondrocytes and reduces the pro-inflammatory response in macrophages, ultimately promoting meniscus healing.

Min Seo Kang was supported by Columbia University Summer Research Fellowship.

11. To What Extent is the Normal Logarithmic Spiral Growth of the Mandible Maintained Amidst TMJ Ankylosis and Craniofacial Malformations

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Introduction: The growth of the human mandible is gnomic and can be represented logarithmically. The mandibular foramen maintains the location of the inferior alveolar neurovascular triad and protects its contents as the mandible grows. Patients with temporomandibular joint ankylosis (TMJa) exhibit abnormal mandibular growth, asymmetry, and dysfunction. TMJa can be detrimental in children, resulting in a bird profile, micrognathia, and airway obstruction. Hemifacial microsomia (HFM), Pierre Robin Sequence (PRS), and Treacher Collins Syndrome (TCS) are three congenital craniofacial malformations that affect the development, form, and function of the mandible.

Objectives: To read and compile the information surrounding the logarithmic spiral growth in the context of TMJa and craniofacial malformations. To compose clinical implications for future research concerning surgical interventions used to treat patients with TMJa and craniofacial malformations.

Materials & Methods: A literature review addressed the question, "To what extent is the normal logarithmic spiral growth of the mandible maintained amidst TMJa and craniofacial malformations?" The keywords used included "Logarithmic Spiral Growth," "TMJa," "Hemifacial Microsomia," "Pierre Robin Sequence," "Treacher Collins Syndrome,""Distraction Osteogenesis," "Curvilinear Distraction Osteogenesis," and "Surgical Interventions for TMJ ankylosis".

Results & Conclusions: Despite TMJ deviations and congenital anomalies, logarithmic spiral growth seems to be maintained. The logarithmic spiral growth trajectory was likely pushed downwards, permitting the contents of the mental foramen to be unoccluded. Earlier treatment permitted optimal mandibular growth, mouth opening, and skeletal development. Further research needs to determine how surgical interventions for TMJa and craniofacial patients restore aspects of the logarithmic spiral curve to enable providers to create individualized treatment plans for correction and maintenance of normal growth.

Discussion: There is no preferred surgical method for treating TMJa. Presently, surgical treatments include gap arthroplasty, costochondral graft, and distraction osteogenesis. Curvilinear distraction osteogenesis (CDO) appears to be the most ideal surgical intervention for HFM, TCS, and micrognathia when coupled with an individualized distractor to correct the patient's deviation from the normal logarithmic spiral curve. CDO follows the rounded shape of the craniofacial skeleton and imitates natural mandibular growth in both the vertical and horizontal dimensions. Schendel appliances allow for the maintenance of the curvature of the spiral while the surrounding bone is moved to a different position relative to the curvature of the spiral, allowing various mandibular deformities to be successfully treated. This allows for stable occlusion and prevents relapse and complications.

12. Microscale Spatial Mechanobiology as a Novel Oral Cancer Biophysical Marker

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Introduction: The study of mechanobiology in dental research has been limited to orthodontic movement, cellular and tissue responses to biomechanical processes, and the functionality of endodontic implants. Oral cancer is the sixth most common cancer worldwide and is associated with high mortality rates, making early diagnosis and treatment key to survival. Current methods of cancer detection often overlook the early stages of cancer. Recently, the micro-scale heterogeneity of cancer has received attention as a potential biomarker to predict cancer prognosis.

Objectives: The current gold standard for cancer screening includes a biopsy followed by histopathological assessment, of which accuracy and consistency are dependent on human factors. Our study explores the potential of micro-scale modulus mapping as an oral cancer diagnosis and prognosis marker.

Materials & Methods: All healthy, precancerous and cancerous biopsy tissue sections were obtained from the Herbert Irving Comprehensive Cancer Center (n = 5 per group). The biomechanical spatial heterogeneity was measured by micro-scale modulus mapping using a Piuma™ nanoindenter with unfixed and unstained tissue slides (n = 7 per group), and a probe (9 µm radius; 10 mN). The effective indentation moduli (E_{eff}) measured for selected 1,000 µm x 1,000 µm sections over 100 µm intervals were analyzed using MATLAB-generated modulus heatmaps. The average and maximum indentation moduli, and their distribution and microregional variances, were quantitatively analyzed, followed by statistical analyses to determine any correlation between the measured outcomes and the respective clinical data.

Results & Conclusions: Tissues that progressed to the carcinoma and invasive carcinoma stages exhibited a considerable increase in the maximum and average E_{eff} compared to dysplasia and no carcinoma. Similarly, the number of points >15 MPa was significantly higher in carcinoma samples, with increased elastic moduli uniformly distributed over cancerous regions. These findings likely indicate that precancerous tissue samples with a heterogeneous distribution of high elastic modulus values are more likely to exhibit greater dysplastic behavior and develop into a carcinoma, when compared to sections exhibiting a more homogeneous spread of elastic moduli.

Discussion: This method of predicting the prognosis of precancerous tissue using micro-scale modulus mapping has significant potential to serve as a quantitative diagnostic aid in the clinical identification and monitoring of oral cancer. The limitation of this study is the small sample size. Thus, we aim to expand the study by obtaining a larger number of patient-matched tissue section samples from various anatomical locations with precancer and cancer status.

Alexandria Lo was supported by the Columbia College of Dental Medicine Summer Research Fellowship and Research Liaison Award.

13. Detection of Sequelae from Acute Meningitis during Examination by a Healthcare Provider

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Introduction: Neurological complications from acute meningitis affect over 30% of survivors, leading to issues like hearing loss, epilepsy, and cognitive impairments. These sequelae, which are sometimes missed by providers due to the delay in their onset, can cause debilitating life challenges for patients, but their full impact is poorly understood due to limited long-term follow-up data, especially in low- and middle-income countries. There is a need for improved care and follow-up, and specific guidelines on ideal timing for follow-up.

Objectives: In collaboration with the "WHO Defeating Meningitis by 2030: A Global Road Map," this study aims to determine the optimal time for evaluating meningitis survivors for sequelae, helping improve detection and management of long-term complications.

Materials & Methods: This systematic review included studies published from databases like MEDLINE, EMBASE, and Cochrane. Studies of various designs, including case-control, cohort, and cross-sectional studies, were included if they documented the timing of sequelae detection. Data on the study location, design, patient numbers, types of sequelae, and timing of diagnoses were extracted. A statistical analysis included descriptive statistics, using Excel and R programming, and a meta-analysis of the prevalence of sequelae detected at different time points.

Results & Conclusions: The analysis included 89 studies, with a total of 9,311 adult and 18,658 pediatric meningitis cases included. For adults, 18% experienced sequelae, which were most commonly detected after discharge, with a mean follow-up time of 5.7 months. For children, 24% developed sequelae. Hearing loss and neurological impairments were the most common sequelae. Mortality was higher during hospitalization, with 13.9% of adults and 12.8% of children. Meta-analysis indicated that the prevalence of sequelae was higher when screened beyond 90 days for both adults and children.

Discussion: This systematic review analyzed 27,969 acute meningitis patients, with bacterial infections being the most common cause of meningitis and its related sequelae in both adults and children. This study highlights the heterogeneity of sequelae presentation and timing, emphasizing the need for standardized and regular follow-up evaluations to effectively manage sequelae. Limitations of the review included a bias towards high-income countries, inconsistencies in follow-up data, and difficulties in distinguishing between acute complications and long-term sequelae.

14. Allele-specific PCR Quantification for *HNRNPH2* Mutant Expression Undergoing Gene Silencing

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Introduction: The ultra-rare, X-linked HNRNPH2-Related Neurodevelopmental Disorder (HNRNPH2-RNDD) is due to de novo pathogenic missense variants in the *HNRNPH2* gene. Patients are often non ambulatory, nonverbal with dysmorphic craniofacial features, intellectual disability, epilepsy, autism, oral stimulation and limited independence. One future therapeutic approach is to silence the mutated allele while preserving the expression of the functional allele.

Objectives: Our goal was to develop a reliable method for distinct, allele-specific quantification of *HNRNPH*2 gene expression after knockdown.

Materials & Methods: Design of allele-specific primers and synthetic double-stranded DNA gene fragments were based on the most-common patient variant, c.616C>T. qPCR components include TaqMan™ Genotyping Master Mix, FAM-labeled (mutant) and SUN-labeled (WT) allele-specific probes, forward and reverse primers (IDT), and *HNRNPH2* WT and synthetic mutant gBlocks™ gene fragments. RNA was extracted, quantified cDNA was generated. Gene expression was evaluated using comparative ΔΔCT qPCR before allele-specific, standard curve expression analysis with the allele-specific primer and probes.

Results & Conclusions: *HNRNPH2* mRNA allele expression was successfully detected and quantified based on gBlock standard curve quantification. Expression levels were measured through allele-specific qPCR (n=4) by plotting along a *HNRNPH2* gBlock standard curve quantity of DNA molecules ranging from 1E+7 to 1E+2 copies. Untreated samples (n=3) produced an average of 43,682 copies compared to the siRNA-treated sample (n=3) average of 14,075 copies, representing a 67.8-fold decrease in *HNRNPH2* expression after gene silencing. However, no allele specific knockdown was observed as both alleles were diminished in a similar fashion.

Discussion: We developed and validated a protocol to quantify gene expression from both *HNRNPH2* alleles. Although nucleic acid knockdown approaches were not specific enough to preferentially target one *HNRNPH2* allele from each other, this developed protocol with be useful after redesigning our gene targeting knockdown strategy with the goal of novel therapeutics for HNRNPH2-Related Neurodevelopmental Disorder.

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15. Structure-function analysis of colorectal cancer-associated virulence factor FadA from *Fusobacterium nucleatum*

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Introduction: *Fusobacterium nucleatum,* a gram-negative oral anaerobic bacterium commonly found in the oral cavity, is associated with both periodontal disease and colorectal cancer. Research suggests that the virulence factor FadA forms an amyloid-like structure to exacerbate the severity of cancer. There are two species of FadA: the intact pre-FadA and cleaved mFadA. Pre-FadA is essential to the formation of amyloid fibrils.

Objectives: This study aims to investigate FadA mutants that produce varying levels of pre-FadA. We hope to identify mutant(s) that generate higher levels of pre-FadA, leading to increased amount of amyloid fibrils compared to the wild type. This will facilitate structural analysis via solid phase NMR in collaboration with Dr. Ann McDermott and Dr. Chengmin He in the Department of Chemistry.

Materials & Methods: Four *E.coli* strains, YH1601, YH1602, YH1606, and YH1607, were grown in liquid culture with 0.1 mM IPTG to an OD of 0.5. SDS-PAGE and Western blot analyses were performed to determine which strain produced the highest pre-FadA concentration. The strain with the highest pre-FadA levels were subjected to Sanger sequencing, revealing an L-9G mutation. This strain was further induced in liquid culture with 0.1 mM IPTG at OD 0.5. It was then purified using TALON Metal Affinity Resin, dialyzed, and lyophilized. A Thioflavin-T binding assay was conducted to assess amyloid activity. Additionally, a 13C 1D spectrum was obtained in collaboration with Dr. McDermott's lab to analyze the structure.

Results & Conclusions: Our results indicate that the L-9G mutant, YH1601, produced higher levels of pre-FadA than the wild type. The Thioflavin-T test demonstrated that while the mutant exhibited reduced activity compared to the wild type, it retained significantly higher activity than the negative control, confirming its function integrity. The 13C 1D spectrum revealed an increased beta-sheet content in the L-9G pre-FadA mutant relative to the wild type. A distinct peak around 50 ppm was observed in the mutant sample, characteristic of beta-sheet alanines.

Discussion: These findings suggest that the L-9G mutation enhances beta-sheet formation in FadA. Future work includes growing a 13C, 15N-labeled sample to obtain more structural insights via a 13C-15N 2D spectrum.

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16. Biological Augmenter 4-PPBP Promotes Fibrocartilaginous Tissue Healing

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Objectives: Fibrocartilaginous tissues are composed of a dense collagen I and II matrix with a low vascular supply. The dense alignment of collagen fibers provides strong resistance to compressive forces and allows for smooth movement. Upon mechanical injury, surgical repair reduces structural lesions and endogenous stem cells are responsible for biological healing. However, low vascularity limits regenerative capacity, and surgical outcomes can have varying satisfaction. This study poses a scalable small molecule, 4-PPBP, as a biological augmenter to promote the recruitment of native stem cells and improve extracellular matrix deposit.

Materials & Methods: Proliferation under inflammation was measured by harvesting bovine meniscus cells and culturing them to 10^5 cells before treatment with IL1β and 4-PPBP. CCK8 absorbance measured the number of viable cells and qPCR analysis quantified the expression of MMP3, IL1β, and IL6. In vitro cellular migration was quantified using human synovial mesenchymal stem cells in a scratch assay treated with 0-20μM 4-PPBP and imaged at 0, 12, and 24 hours.

Results & Conclusions: Groups treated with 4-PPBP showed a significant increase in cellular proliferation at both time points measured, 24 and 48 hours, with expression being close to twice that of the DMSO control. qPCR analysis illustrated the inhibition of catabolic metabolism and inflammatory markers IL1β and IL6 expression in the response to IL1β stimulation. Cellular migration also increased in the 4-PPBP groups with 10μM showing the highest increase in cellular integration and bridging compared to the control.

Discussion: 4-PPBP has serious potential in promoting wound healing in fibrocartilaginous tissues that are restricted in their healing abilities. These capabilities suggest that 4PPBP may function as a novel anti-inflammatory compound that allows the cell to adapt to the proinflammatory niche post-injury and surgery.

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17. Xerostomia and Temporomandibular Disorders in Participants with Post-Acute Sequelae of SARS-CoV-2

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Introduction: The COVID-19 pandemic has left a significant mark on global health, not only due to its acute manifestations but also its long-term symptoms, collectively referred to as Post-Acute Sequelae of SARS-CoV-2 (PASC). Few studies have explored the impact of PASC on the craniofacial region, leaving its effects uncertain. Xerostomia, a frequent symptom of acute COVID-19, and temporomandibular disorder (TMD), a chronic pain condition in the jaw and associated muscles, can severely impair quality of life, making it crucial to understand their association with PASC through further investigation.

Objectives: This study investigated the prevalence of xerostomia and TMD in individuals with and without PASC.

Materials & Methods: This study included 122 participants previously infected with COVID-19, divided into two cohorts: those with PASC (n = 74) and those without PASC (n = 48). The Xerostomia Index (55 points = severe xerostomia) was used to assess xerostomia and a point-based index questionnaire (≥3 points = TMD+) was used to assess TMD. Statistical analyses were conducted to compare the prevalence of these conditions between the groups using t-tests and Chi-square tests.

Results & Conclusions: TMD scores were significantly higher in the PASC group compared to the non-PASC group (1.42 ± 2.04 vs 0.42 ± 1.13, $p = 0.0024$). The prevalence of TMD was also significantly higher in the PASC group (17/74; 22.97% vs 2/48; 4.17%, $p = 0.0047$). This difference was further observed in non-Black participants (14/56; 25.00% vs 2/32; 6.25%, $p = 0.0423$) and females (16/57; 28.07% vs 1/31; 3.22%, $p = 0.0043$). Average xerostomia scores were also notably higher in the PASC group (25.42 ± 9.93 vs 16.25 ± 6.44, $p < 0.0001$). This trend was maintained across Black (24.00 ± 8.56 vs 15.81 ± 6.42, $p = 0.0038$), non-Black (25.89 ± 10.37 vs 16.47 ± 6.54, $p < 0.0001$), male (19.71 ± 8.02 vs 13.94 ± 4.80, $p = 0.0161$) and female (27.16 ± 9.86 vs 17.52 ± 6.92, $p < 0.0001$) participants.

Discussion: Our findings suggest a strong association between PASC and increased TMD and xerostomia scores. These findings underscore the need for further research into the mechanisms underlying these conditions in PASC patients and highlight the importance of early detection and management.

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