Journal of the William Jarvie Society

Volume 63, Spring 2020

Editor-in-Chief
Bobby Lin '21

Associate Editors
Scott Noh '21, George Lin '22, Glenna Lee'22

"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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Message from the Editor

As the Editor-in-Chief of the 2019-2020 academic year, I am pleased to present the 63rd edition of the Journal of the William Jarvie Research Society. The variety and depth of research presented here speaks volumes about the extraordinary commitment to research at the College of Dental Medicine. The dedication and vision of our faculty is reflected in the high quality of research conducted under their mentorship.

I would first like to thank Dr. Carol Kunzel and Ms. Kelli Johnson whose support and guidance made this journal possible. Their effort to ensure the success of Birnberg Research Day and continue Columbia University College of Dental Medicine's tradition of research excellence should be commended. It was a great honor to work with them this past year as editor-in-chief. Additionally, I would like to thank Dean Stohler, Dean Fine, and Dean Wolf for their continued support of student research, and contributing their heartfelt words for this year's journal.

This journal was prepared with assistance from my associate editors: Glenna Lee, George Lin, and Scott Noh. Their time and efforts were crucial to the preparation of this journal. I would also like to thank the William Jarvie Research Society executive board for their hard work throughout the year, especially this year's President and Vice President, Anjali Dave and Gabe Kaye, whom have helped guide our editorial team and make this process more efficient throughout the year.

Finally, I would like to express a big thank you to all of our members. We are fortunate to be surrounded by such enthusiastic and committed students in their research and the pursuit of knowledge.

Congratulations to all the students who have published abstracts in this year's journal. I hope that their outstanding efforts inspire future students to pursue research of their own and add to the thriving research community at Columbia University.

Sincerely,

Bobby Lin
Editor-in-Chief *2019-2020*
William Jarvie Research Society

April 6, 2020

Dear Members of the Jarvie Society and CDM Community,

Research is the vehicle through which we advance the benefits of dentistry, allowing us to branch into new territories with new ideas. It is through research that we as individuals and as a school will continue to integrate dentistry into personalized healthcare and interdisciplinary medicine, and the results will reverberate locally and worldwide.

Virtual Birnberg 2020 is an important opportunity for us to affirm and demonstrate our commitment to the merits of scholarship and research. I am very proud of your initiative taking to advance your knowledge and your profession, and for helping to make the College of Dental Medicine an institution that is shaping the future of dental medicine and oral health.

The quality and breadth of the student research presented here, as well as the opportunity to witness the cooperative relationship between students and faculty mentors, make the Virtual Birnberg 2020 an inspiring event for me. I am grateful to you for all you do on behalf of the school and our community in these very challenging times, and I congratulate you on your very hard work.

Sincerely,

Christian S. Stohler, DMD, DrMedDent
Professor and Dean, College of Dental Medicine
Senior Vice President, CUIMC

April 2, 2020

Dear William Jarvie Research Society Members,

The global pandemic we currently face has brought much unease and uncertainty. Despite our current challenges, CDM remains committed to its education, research, and patient care missions. Student research enriches the educational experience and promotes a culture of inquiry and discovery. We take great pride in the degree to which students and residents at CDM engage in research and scholarly activity. Showcasing that research in the Jarvie Journal and during Birnberg Day is one of our most time-honored traditions. I am delighted that although we can't be together physically, we will be recognizing student research during Virtual Birnberg 2020.

The faculty and administration at CDM applaud your hard work and hope you will continue to develop your interest in scientific inquiry.

Congratulations on your research achievements!

Warm Regards,

Dana L. Wolf, DMD, MS
Associate Dean for Predoctoral Academic Affairs

College of Dental Medicine
Columbia University Irving Medical Center

April 7, 2020

Dear Jarvie Society Members,

All great institutions have great traditions. I am happy that the research tradition remains strong in the Columbia student body as evidence by the mix of basic research and clinical studies.

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 College of Dental Medicine's mission of producing leaders in the field of oral health care.

Congratulations to all participating in Birnberg Research Day. We look forward to your future research endeavors and professional accomplishments.

Sincerely,

James Burke Fine, DMD
Senior Academic Dean, Postgraduate, Graduate and Continuing Education Programs
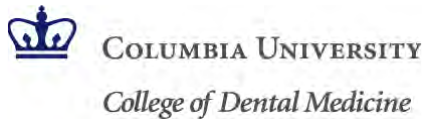
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March 31, 2020

Dear Members of the Jarvie Society and CDM Community:

Birnberg Day celebrates the student research program at the Columbia University College of Dental Medicine when students present their projects to the health sciences community and beyond. This year's event holds an honored place on the school's academic calendar as the first Virtual Birnberg to be held. For nearly a year students have been preparing for this event through commitment to the completion of their projects.

Research is essential for the vitality and the forward momentum of the dental profession. The publication of the first electronic issue of the Journal of the Jarvie Society is cause for celebration, as are the audio and visual poster presentations made at this year's Virtual Birnberg 2020. Many of you have also had the opportunity to present your work at local, regional, national, and international dental meetings, receiving numerous awards for your research accomplishments at such meetings.

I extend my warmest congratulations to all of you on the completion of yet another successful year. The abstracts in this issue reflect well on the excellent work that so many of you have done under the mentorship and guidance of dedicated faculty members who have supervised and supported the work presented here.

Our school was founded by William Gies who believed that one way in which the profession could best serve the public was to subscribe to a culture of inquiry. Our student researchers and their mentors embody that spirit, as well as move it forward, at the College of Dental Medicine.

Sincerely,

Carol Kunzel, PhD

Columbia University Irving Medical Center

History of the William Jarvie 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.

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*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-two 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	1978 Dr. David Scott	1999 Dr. James D. Bader
1955 Dr. Joseph Appleton	1979 Dr. Berge Hampar	2000 Dr. Lars Hammerström
1956 Dr. Isaac Schour	1981 Dr. Ronald Dubner	2001 Dr. David T. W. Wong
1957 Dr. Ralph Phillips	1982 Dr. Martin A. Taubman	2002 Dr. Henning Birkedal-Hansen
1958 Dr. Reider F. Soqnnaes	1983 Dr. Louis T. Grossman	2003 Dr. Barbara Dale-Boyan
1959 Dr. John Knuston	1984 Dr. Solon A. Ellison	2004 Dr. Paul B. Robertson
1960 Dr. Maxwell Karshan	1985 Dr. Norton S. Taichman	2005 Dr. Bruce L. Pihlstrom
1961 Dr. George Paffenbarger	1986 Dr. Ronald J. Gibbons	2006 Dr. Jeffrey D. Hillman
1962 Dr. Eli Goldsmith	1987 Dr. Robert J. Gorlin	2007 Dr. Ralph V. Katz
1963 Dr. Edward V. Zegarelli	1988 Dr. Enid A. Neidle	2008 Dr. Robert J. Genco
1964 Dr. Francis A. Arnold	1989 Dr. David H. Pashley	2009 Dr. Deborah Greenspan
1965 Dr. Seymour Kreshover	1990 Dr. William H. Bowen	2010 Dr. Sally J. Marshall
1966 Dr. Paul Goldhaber	1991 Dr. Harold C. Slavkin	2011 Dr. Michael Longaker
1968 Dr. Sholom Peariman	1992 Dr. George R. Martin	2012 Dr. R. Bruce Donoff
1970 Dr. Melvin Moss	1993 Dr. Richard Skalak	2013 Dr. Peter J. Polverini
1971 Dr. Irwin Mandel	1994 Dr. Ze"ev Davidovitch	2014 Dr. Henry Ginsberg
1973 Dr. Lester Chan	1995 Dr. Ivar Mjor	2015 Dr. Laurie K. McCauley
1975 Dr. Russell Ross	1996 Dr. Lorne M. Golub	2016 Dr. Rena D'Souza
1976 Dr. Jerome Schweitzer	1997 Dr. Bruce J. Baum	2017 Dr. George Hripcsak
1977 Dr. George Green	1998 Dr. Kenneth Anusavice	2018 Dr. Jeanette M. Wing
		2019 Dr. Gordana Vunjak-Novakov
		2020 Anil K. Rustgi

2020 Birnberg Speaker and Research Awardee:
Anil K. Rustgi, MD

Anil K. Rustgi is the Director of the Herbert Irving Comprehensive Cancer Center at NewYork-Presbyterian/Columbia University Irving Medical Center. Dr. Rustgi is a world-renowned leader in the field of gastrointestinal oncology. His interdisciplinary research focuses on tumor initiation, the tumor microenvironment and tumor metastasis in the context of gastrointestinal cancers, including cancer of the esophagus, pancreas, and colon. Dr. Rustg's lab works to translate their discoveries into improving molecular diagnostics and finding new experimental therapeutics for patients, and is funded through several grants including an NCI P01 (program project on esophageal cancer), an NCI U54 on Barrett's esophagus, two NIH R01 grants (for pancreatic cancer and colon cancer) and an American Cancer Society Research Professorship.

He has more than 300 publications and his work has appeared in high-impact journals such as Nature, Nature Genetics, Nature Medicine, Cancer Cell, Genes and Development, Gastroenterology, Journal of Clinical Investigation, PNAS and New England Journal of Medicine.

He has been elected to the American Society of Clinical Investigation and the Association of American Physicians and is a Fellow of the American Association for the Advancement of Science. Previously, he was president of the American Gastroenterological Association (17,000 members), editor-in-chief of Gastroenterology, and president of the International Society of Gastroenterological Carcinogenesis. Dr. Rustgi will serve as president of the American Pancreatic Association.

He has been recognized for his contributions with numerous awards, including the AGA Julius Friedenwald Lifetime Achievement in Gastroenterology Medal (2017), AGA Distinguished Mentor Award (2016), the Ruth C. Brufsky Award for Excellence in Research in Pancreatic Cancer (2013), the Distinguished Achievement Award from the South Asian American Society for Cancer Research (2012), and an American Cancer Society Research Professorship. In addition he received the top mentorship awards (Arthur Asbury for faculty and one from the postdoctoral fellow program) from his tenure at the University of Pennsylvania.

Dr. Rustgi graduated summa cum laude from Yale College with a bachelor's degree in molecular biophysics and biochemistry (departmental honors) and earned his medical degree at Duke University School of Medicine, where he was elected to Alpha Omega Alpha, the national medical honorary society. He completed an internal medicine residency at Beth Israel Hospital and a GI fellowship at Massachusetts General Hospital (MGH), both of which are affiliates of Harvard Medical School. He also rose to associate professor of medicine at MGH before joining the University of Pennsylvania in 1998, where he served as Chief of Gastroenterology and directed two Centers and NIH T32 training grants until 2018.

Dr. Rustgi's lecture has been postponed to a later date.

Birnberg Research Program

Tuesday, April 7, 2020
Schedule of Events

Birnberg Research Program Lecture – College of Dental Medicine

> **To be rescheduled:**
> Anil K. Rustgi, MD
> Director, Herbert Irving Comprehensive Cancer Center
> Irving Professor of Medicine
> Associate Dean of Oncology
> Columbia University Vagelos College of Physicians & Surgeons

Virtual Student Table Clinic and Research Poster Session

April 7   Open Session (open to public)
                     Links available on April 7

April 7- April 10   Virtual Judging Session
                     Presenter abstracts sent to judges on April 6

A Message from the President of the William Jarvie Research Society

As the President of the William Jarvie Research Society, I am very excited to share with you all the 63rd edition of the Jarvie Journal. It is hard to believe that a year has passed and we are already coming together in 2020 to celebrate the research done by our students over the past year. The Jarvie Research Society is a student-run organization whose purpose is to encourage, promote, and support the spirit of discovery. As an organization, we hope to enable every interested Columbia dental student to have a satisfying and productive research experience during their time at CDM. We hope to foster research and knowledge concerning oral health problems and aim to disseminate this information to the dental community at large. This year's Journal has a breadth of diverse and high quality abstracts from both predoctoral and postdoctoral students in several research categories including the basic sciences, behavioral sciences and public health. Congratulations to those students who are participating in this year's Birnberg program and continuing Columbia's legacy of producing the highest level of research. This has been an incredible year for the Jarvie Research Society. We welcomed the class of 2023 and created various monthly workshops introducing them to research experiences both within CDM and externally.

Through our club support, we have encouraged our upperclassmen student members to present at various national meetings. In fact, we had students this year receive fellowships from many prestigious associations including the NIH Summer Research Fellowship, the Margaret Mahoney Research Fellowship, and the AADR Summer Research Fellowship. We are excited to have had one of our club members elected for a national position of the AADR National Student Group (NSRG) as the Vice President, reflecting our school's leadership involvement at both the local and national level. Moreover, this year we had predoctoral students share their research findings at the Hinman Student Research Symposium, the NIH Summer Poster Session, the ADA Foundation Annual Meeting, the National Oral Health Conference, and the Greater New York Dental Meeting. AADR Advocacy Day, IADR/AADR/CADR General Session and Annual Meeting, ADEA Annual Session and quite a few other conferences were closed due to the current circumstances. Fortunately, we are still able to continue with this year's Birnberg program, albeit in an unconventional way. This is the first year that Birnberg will be done virtually. I want to thank everyone participating for adapting to the changes we have had to implement and helping make today possible.

In closing, I would like to take some time to sincerely thank Dr. Carol Kunzel and Ms. Kelli Johnson. The success of the Jarvie Research Society and the advancement of research at CDM is due largely to their commitment to us as students, their guidance in the preparation of the Jarvie Journal, and their dedication to organize the annual Birnberg program. Our local student research group has not only been able to flourish, but has also been able to achieve our mission with the help of their inspirational guidance and mentorship. I would additionally like to thank Dean Christian Stohler for his tireless enthusiasm and commitment to increase the level of student research involvement at the dental school. Lastly, I feel truly fortunate to have worked with such motivated and passionate students that encompass our local executive board. In particular, I would like to thank our Editor in Chief Bobby Lin, who worked tirelessly to organize and publish this edition of the Jarvie Journal. It has truly been an honor to work alongside Gabriel Kaye, our Vice President, and Madeleine Daily, Annie An, Rachel Cubilla, Ali Lemkuil, Glenna Lee, George Lin, Scott Noh, Alex Pascal, Rachel Brooke, and Eileen Zheng. Thank you all for your commitment, dedication, and enthusiasm to further the ideals of our forefather William Jarvie by working to encourage, promote and support dental research.

Sincerely,
Anjali Dave
Class of 2021

2019-2020 William Jarvie Society Membership

Officers:		
	President:	Anjali Dave '21
	Vice President:	Gabe Kaye '21
	Editor-in-Chief:	Bobby Lin '21
	Assistant Editors:	Scott Noh '21
		Glenna Lee '22
		George Lin '22
	Secretary:	Madeleine Daily '22
	Treasurer:	Annie An '22
	Communications Coordinator:	Rachel Cubilla '22
	Advocacy Representative:	Alison Lemkuil '22
	Columbia Research Committee D3 Member	Alexander Pascal '21
	Columbia Research Committee D2 Member	Rachel Brooke '22
	Columbia Research D1 Representative	Eileen Zheng '23

Advisors:

Dr. Carol Kunzel
CDM Director of Research

Ms. Kelli Johnson
Student Affairs Administrator

Members:

Abby May	David Walton	Jordan Cimilluca	Rachel Brooke
AJ Nardone	Elena McCormick	Joshua Yaminian	Rachel Cubilla
Alec Litrel	Elisa Carbonell	Julianne Andrade	Rahul Gupta
Alex Besmer	Elliot Shine	Justin Kim	Riley Reardon
Ali Lemkuil	Emily Horowitz	Kavita Shah	Rishabh Rattan
Alyson Bogart	Gabriel Kaye	Kimberly Mei	Ryan Foree
Alyssa Hanel	George Lin	Laurel Leavitt	Samuel Fleisher
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Ashleigh Alex	Heather Kim	Nadia Mezghani	Sukhneet Sahota
Carlos Galvez	Ho Yun Ryu	Parker Green	Susan Park
Carol Liu	Jeff Luchetti	Paul Sim	Yejin (Annie) An
Daniel Geanon	John Baker	Paula Munoz	

Pre-Doctoral Student Abstracts:
Molecular, Cellular, Tissue, System, Regenerative Medicine, & Organism Biology and Physiology

1"Investigating Specificity of Oxo-M and 4-PPBP to CD146+ Stem/Progenitor Cells"

Ye Jin An[1], Gayoung Park[1], Eugenia Lee[2], Chang H. Lee[1,2]

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

Background: Chronic periodontitis causes periodontal attachment loss and frequently results in tooth loss. Several regenerative treatments, including guided tissue regeneration, delivery of growth factors (e.g. Emdogain), and root surface modification are currently available for improving clinical outcomes. However, no therapy exists to date that enables regeneration of the periodontal tissues as the targeted clinical goal. We have previously reported that a novel combination of pharmaceutical small molecules, Oxo-M and 4-PPBP, has potential to guide endogenous regeneration of dense fibrous connective tissues, such as periodontal ligaments (PDL) or tendons, by inducing fibrogenic differentiation of CD146+ stem/progenitor cells via FAK and ERK1/2 pathway.

Objectives: This study is designed to investigate the specific mechanism for Oxo-M and 4-PPBP through acetylcholine (ACh) receptors and σ1 receptor pathways in CD146+ stem/progenitor cells from PDL or tendon.

Materials & Methods: CD146+ stem/progenitor cells were isolated either from human PDL or rat patellar tendons, which share stemness characteristics. ACh levels in conditioned media were measured with ACh assay. Upon treatment of various combinations of 1-10 U/mL AChE, 1 mM Oxo-M, and/or 10 μM 4-PPBP, Western Blot was performed at 6-12 hours of treatment to check phosphorylation of ERK1/2 and FAK. Fibrogenic expressions were evaluated by qRT-PCR at 1 week, including COL-I, COL-III, Tn-C, VIM, TnmD and Scx. As candidates for secondary signaling mediators, PLC, PKC, and DAG expressions were measured with ELISA kit at 6-12 hours after Oxo-M and 4-PPBP treatment.

Results & Conclusions: Western blot showed p-ERK1/2 with Oxo-M + 4-PPBP treatment that is diminished by AChE. The qRT- PCR result showed that all the mRNA markers were significantly increased by Oxo-M and 4-PPBP treatment for 1 week. With AChE treatment, significant reductions of expressions were observed in Tn-C, TnmD and Scx induced by Oxo-M and 4-PPBP. Oxo-M and 4-PPBP treatment induced no significant difference in the expressions of PLC, PKC, and DAG at 6-12 hours.

Discussion: Our findings suggest the autocrine signaling of ACh in Oxo-M and 4-PPBP-induced fibrogenic differentiation of CD146+ stem/progenitor cells. PLC pathway, well-described in neuronal system, is not involved in the Oxo-M + 4-PPBP-induced differentiation. Follow-up study will extend to investigate other pathways including Src and TrkB. This study has implication in periodontal ligament regeneration via specific targeting of endogenous stem/progenitor cells.

2"Design and Construction of Human CRISPR Activation Guide RNAs for Epigenome Editing of Craniofacial Disorders"

Silvia Baila[1], Michelle N. Skelton[1], Sunil Wadhwa*[1], Christopher L. Ricupero[1]

[1]College of Dental Medicine, Columbia University, New York, New York *Faculty mentor

Background: Current regenerative treatment strategies for many craniofacial disorders fail to restore tissues to their native state. Cell fate programming is an attractive approach however, it will likely require a multi gene transcriptional control. We present an innovative strategy to build and apply a modular dCas9-VPR CRISPR activation (CRISPRa) platform to precisely target, epigenetically edit and stimulate essential genes in craniofacial, ligament/tendon and neurological disorders such as Angelman syndrome and periodontitis. We hypothesize that properly designed guide RNAs (gRNAs) with dCas9-VPR will target and stimulate endogenous gene expression.

Objectives: Design, construct and screen molecular components for a CRISPR activation platform for precise gene modulation.

Materials & Methods: Human gRNAs were designed using the Genetic Perturbation Platform algorithm. Each was ranked for specificity and off target activity. gRNAs were targeted within 250 base pairs of each transcriptional start site of Angelman Syndrome related genes UBE3A, GABRB3 and periodontal ligament/tendon transcription factors MKX, SCX. 4-5 gRNAs were chosen per target gene and inserted into a GFP expressing vector pSB700 plasmid (A.Chavez). NEB Stable E. coli were used for plasmid transductions and four colonies per gRNA were picked for sequence verification. CRISPRa components included Sp-dCas9 fused with transcriptional activator VPR and four gRNAs per gene.

Results and Conclusions: 17 designed human guide RNA plasmids were cloned into the GFP expressing gRNA plasmid. After DNA sequencing 72 picked colonies (n=4 per gene + 4 no insert controls), we verified that the gRNA inserts were present and in sequential order. We observed a 94% cloning efficiency. Transfection efficiency of HEK293-T cells was evaluated using a separate GFP plasmid. Cell viability and efficiency was robust and >80%. Initial qPCR CRISPRa screens with dCas9-VPR and gRNAs (4-5 per gene) displayed mixed results. Screening identified best performing gRNAs for SCX and MKX, producing a 141 and 4.4 fold increase respectively post 48 hours. Interestingly, UBE3A and GABRB3 did not show any significant upregulation compared to baseline.

Discussion: We successfully designed, cloned and evaluated 17 human guide RNAs for the CRISPR activation platform. These components precisely target and modulate endogenous gene expression through epigenetic editing. Screening identified gRNAs capable of robust activation. Non-stimulating gRNAs may need to be redesigned. Although gRNAs were designed and targeted two unrelated disorders, Angelman Syndrome and periodontitis/tendon injuries have substantial health burdens on society. Therefore, this proof of principle platform highlights its modularity which can be utilized for multiple craniofacial disorders, disease or repair.

3"Heparin-conjugated Bio-glue to Promote Healing of Lubricin-Coated Fibrocartilage Injuries"

Rachel Brooke[1], David Xiang[2], Solaiman Tarafder[2], Chang Lee[1,2]

[1]College of Dental Medicine, Columbia University, New York, New York

[2]Center for Dental and Craniofacial Research, Columbia University, New York, New York

Background: Meniscus injuries occur in over one million Americans each year and represent one of the most important contributing factors to knee osteoarthritis (OA). Tears in the inner third, avascular region of the fibrocartilaginous tissue have poor healing capabilities and orthopedic attempts to repair them are often not successful. Our group recently demonstrated the potentially harmful effects of lubricin, a proteoglycan abundant in synovial fluid, on the healing of fibrocartilaginous tissues such as knee meniscus and TMJ disc. This study advances our approach to mesenchymal stem-cell (MSC) repair of torn avascular fibrocartilage by using a connective tissue growth factor (CTGF)-loaded bio-glue mixed with PLGA microspheres (µS)-encapsulating transforming growth factor beta 3 (TGFβ3) capable of tethering lubricin on torn tissue surfaces.

Objectives: Given the heparin binding domain at the N terminal of lubricin, we applied a heparin-conjugated fibrin gel cross-linked with genipin to our established explant model of avascular tear healing and assessed its ability to recruit and integrate stem-cells into lubricin infiltrated fibrocartilage.

Materials & Methods: Our well-established fibrocartilage explant model using bovine menisci was applied. We tested 4 different bio-glues: (i) fibrin (Fibrinogen and thrombin), (ii) fibrin cross-linked with genipin (Fib-Gen), (iii) fibrin mixed with genipin (free Hep-Fib-Gen), (iv) heparin cross-linked with genipin (Conjugated Hep-Fib-Gen). Heparin-conjugated fibrinogen was synthesized using standard carbodiimide chemistry. Lap shear tests were performed using strips of lubricin-coated meniscus with 0.02 mm/s displacement. In our explant model, the bio-glues were loaded with CTGF and TGFβ3 (µS) and applied to incised menisci pre-treated with synovial fluid or PBS (control). The explants were cultured with MSCs and fibrocartilaginous supplements for 4 wks, followed by histological, biochemical and mechanical testing analysis.

Results and Conclusions: Lap shear tests with lubricin-coated meniscus tissue showed that conjugated Hep-Fib-Gen had a significant increase in shear modulus as compared to the Fib, Fib-Gen and free Hep-Fib-Gen bio-glues (n = 8 - 15 per group; p<0.0001). After 4 wks of explant culture, only the conjugated Hep-Fib-Gen glue showed a notable improvement in tissue integration of lubricin-coated avascular meniscus tears as compared to the control without lubricin. Our data suggested that heparin conjugated to fibrin in a Hep-Fib-Gen hydrogel strengthened the initial bonding of lubricin-coated meniscal tissues, and thereby improved avascular meniscus healing in an explant model.

Discussion: In human patients there is an inevitable period of 2-3 weeks between the meniscus injury and the first doctor's visit. During this time, injured tissue surfaces are likely penetrated by lubricin through exposure to synovial fluids. Our previous work consistently showed the detrimental effects of lubricin coating on the healing of avascular meniscus tears by bio-glue delivered with CTGF and TGFβ3. In this study we found that heparin conjugation further increased the mechanical properties of fibrin cross-linked with genipin when applied to lubricin infiltrated fibrocartilage. Heparin conjugated Fib-Gen may serve as an efficient bio-glue to promote MSC healing of clinically relevant injuries on fibrocartilaginous tissues including TMJ disc and knee meniscus.

4"Behavioral differences between AB and Turku zebrafish (*Danio rerio*) strains"

Elisa Carbonell[1], Diego Baronio[2], Pertti Panula[2]
[1]College of Dental Medicine, Columbia University, New York, New York.
[2]Department of Anatomy, Faculty of Medicine, Neuroscience Center, University of Helsinki, Helsinki, Finland

Background: Zebrafish (*Danio rerio*) have become a popular tool in neuroscience because it shares genetic homology with humans, possesses all main neurotransmitter and its transparency during embryonic stage and rapid external development allow *in vivo* visualization of cell biological events. Different strains of this teleost exist and they can differ not only on their anatomy, but also behaviorally. Understanding these differences is crucial to use this organism to model brain disorders. To assess whether strain differences are already present at early stages of development we have exposed zebrafish larvae of the AB and Turku strains at 6 days post fertilization (dpf) to visual as well as acoustic/vibrational stimuli and evaluated their behavior.

Objectives: To evaluate the response of zebrafish larvae of the AB and Turku strains at 6 dpf to visual and acoustic/vibrational stimuli.

Materials & Methods: We evaluated the response of zebrafish larvae to sudden changes in illumination (dark-flash response). Briefly, after initial 5 min of basic locomotor activity tracking larvae (, n=23 AB and n=21 Turku) were exposed to alternating 2 min periods of darkness and light, and with three periods of darkness in total. The locomotor activity was analyzed in 1 min bins. The protocol for the acoustic/vibrational startle response consisted of 5 minutes of acclimation to the behavioral system followed by 10 acoustic/vibrational stimuli with a 20s inter-stimulus interval (ISI), a 10 min pause followed by 30 acoustic/vibrational stimuli with a 1s ISI (n=17 AB and n=22 Turku). For both behavioral tests larvae were individually tracked in 48-well plate using the DanioVision system and EthoVision XT software.

Results and Conclusions: Zebrafish larvae have the innate tendency to increase their locomotion after a sudden change in illumination. During a period of sudden darkness both strains demonstrated an increase in total distance moved with the Turku strain showing a stronger response during the first and third dark phase. During the evaluation of acoustic/vibrational startle response the Turku strain showed a stronger decrease in their startle response (maximum velocity) after repeated stimuli, indicating that the larvae habituated faster than the AB strain.

Discussion: In the dark-flash response Turku larvae showed an increased locomotor activity when compared to the AB larvae. In the acoustic/vibrational startle paradigm there was an increased habituation or non-associative learning in the Turku over the AB larvae. Acoustic startle responses in zebrafish larvae are mediated by the bilateral Mauthner cells. However, it has been shown that the mechanism behind the response to sudden darkness is not dependent on these cells. Different explanations have been suggested for the innate tendency of increased locomotor activity displayed by zebrafish after sudden darkness. One of them is that dark-induced hyperactivity may serve to facilitate navigation back to well-lit environments. Behavioral, biochemical and pharmacological evidence suggests that the monoaminergic systems may play a role in the regulation of this behavior. The present results indicate that future studies comparing not only behavioral aspects, but also different neurotransmitter systems, of different zebrafish strains could contribute to a better understanding of this model organism.

5"Identifying *de novo* Variants in Esophageal Atresia/ Tracheoesophageal Fistulas"

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Background: Esophageal atresia/tracheoesophageal fistula (EA/TEF) is a congenital defect with an unknown etiology. Previous studies conducted by our lab performed exome sequencing of unrelated simplex trios (probands and parents) which identified an increased rate of *de novo* deleterious variants in known and novel genes that are expressed at higher levels in the developing esophagus. Our goal with this project was to recruit more families affected by EA/TEF and gather medical history and saliva sample for sequencing. We then planned to analyze the sequencing data to identify potential candidate genes/ variants that could implicated in the development of EA/TEF. We also plan to collect longitudinal medical information from our participants in order to better understand the long-term course of this defect which will eventually allow us to provide more comprehensive information to those diagnosed with EA/TEF.

Objectives: My project was divided into two phases. In the clinical phase, I aimed to recruit new families with EA/TEF and to gather medical history and saliva/blood samples for genomic sequencing. I used Sanger Sequencing to confirm mutations identified through exome sequencing as true *de novo* variants.

Material & Methods:
Subject Recruitment: Patients with EA/TEF were identified at Columbia University Medical Center. We also identified several international participants through support groups for families with EA/TEF. The eligibility criteria included patients diagnosed with EA with/without TEF of any age. Saliva samples were collected from both the proband and the parents. When possible, saliva samples were also collected from the proband's sibling. A medical history was taken at the time of enrollment.

Identification of *de novo* variants: DNA was used for exome sequencing in fifty-one trios and identified *de novo* variants in the proband. In order to confirm these variants, we performed Sanger Sequencing. The sequencing results were analyzed to ensure the variant was present in the proband and that it was absent in both parents. Variants confirmed in the proband and absent in both parents were categorized as *de novo*.

Results: Over the summer we recruited thirty new participants, including both local and international families. Of fifty-one variants identified by exome sequencing of trios, thirty-nine were confirmed as *de novo* variants in the proband. Three variants were confirmed in both the proband and at least one parent, meaning these were not *de novo* variants. In four samples, the assay was not successful due to a too high GC content or poor DNA quality from the sample. Finally, in five samples the variant could not be confirmed in the proband.

Discussion: The thirty-nine samples that were confirmed show that the patient with EA/TEF possessed a *de novo* variant in a gene that is a candidate for the pathogenesis of EA/TEF. The next step in this project is to analyze the variants for predicted pathogenicity and assess the function of the genes to see their potential relationship to esophageal development.

6 *"Listeria monocytogenes* colonization in mice is context and strain dependent"

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Background: *Listeria monocytogenes* is a pathogen which affects an estimated 1,600 people in the United States every year, and of those infected, about 260 die. Pregnant women are 10 times more likely to be affected by listeriosis than the general population and account for 1 in 6 of all cases of listeriosis. Symptoms of infection during pregnancy are typically mild and flu-like but can result in miscarriage, stillbirth, and preterm birth, which is the number one cause of infant mortality and morbidity.

Objectives: We seek to examine listeria colonization in non-pregnant and pregnant mice, in a hope to identify protective mechanisms to combat infection. Our objective is to determine if different strains colonize non-pregnant and pregnant mice differently. We hypothesized that *Listeria monocytogenes* colonization in mice is context and strain dependent.

Materials & Methods: 12-week-old C57BL/6 mice were mated in a 1:1 female to male ratio. The day the plug was found was noted as the first day of pregnancy (E1) and the female was subsequently placed in an isolated cage. Pregnancy was confirmed by tracking the weight of the dam on a daily basis. On E17 the mouse was infected via oral gavage with approximately 5 x 10^9 CFU of *L. monocytogenes* strains 10403 or 320. After 24 hours, the mice were euthanized, and the placentas (from pregnant mice), liver and spleen were collected. The organs were homogenized in PBS, followed by serial dilution and plating on LB agar plates to determine live bacterial titer in each organ. The pups were determined as alive or dead by their response to stimulation.

Results and Conclusions: Strain 10403 colonized liver and spleen significantly higher in pregnant than non-pregnant mice. In contrast, strain 320 colonized liver and spleen more efficiently in non-pregnant than pregnant mice. 10403 colonized the placentas with an enhanced trend, compared to 320, although the difference is not significant. These results indicate that *Listeria* colonization in mice is both context (pregnant vs. non-pregnant) and strain dependent. 10403 preferentially colonize pregnant mice, while 320 preferentially colonize non-pregnant mice. Of the pregnant mice infected with strain 10403 (n=6) four died or were near death. In contrast, of the pregnant mice infected with strain 320 (n=6) only one died. None of the non-pregnant mice died but those infected with strain 320 (n=6) all had organ colonization while for those infected with 10403 (n=6) only two had organ colonization.

Discussion: Our findings indicate that *Listeria monocytogenes* colonization in mice is context and strain dependent. We found that 10403 S affects pregnant mice more than 320 S. Notably, however, 320 S is more harmful to the control (non-pregnant) mice. However, when comparing the effects of 10403 S and 320 S to the placenta of experimental mice we found that both have high levels of colonization with no statistically significant difference between the two. We conclude that *Listeria monocytogenes* negatively affects the placenta regardless of the strain, whereas the effect to other organs (liver and spleen) is both context and strain dependent. Previous work showed that the placenta was used by *Listeria monocytogenes* as a reservoir to infect the liver and spleen, which is likely the case for 10403, but not for 320.

7"Metabolic profiling of mucosal and exocrine tissues in oral chronic graft-versus-host disease"

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Objectives: Salivary glands (SG) and oral mucosa (OM) are primary sites of oral chronic graft-versus-host disease (cGVHD). The graft-versus-host reaction following allogeneic hematopoietic stem cell transplant (HSCT) is initiated via aberrantly activated donor T cells. Tissue resident memory T cells (Trm) express CD69 and CD103 and typically function in homeostatic tissue surveillance, however, emerging data supports a pathogenic role for Trm in autoimmune disease. Skin Trm depend on fatty acid (FA) oxidation acquired exogenously through the overexpression of membrane receptors (e.g. FABP4/5), but this is not defined in other organs. This study was designed to identify metabolic pathways to support cell survival and function of Trm in oral tissues during cGVHD.

Materials & Methods: SG and OM tissue samples for this study derived from patients enrolled in NIH trials and a well-characterized murine model of cGVHD. To assess the potential use of enzyme histochemistry as a tool to evaluate metabolic profile of cells within tissue sections, we performed an *in situ* enzyme activity assay that employs detection reagent redox-sensitive tetrazolium salt nitroblue tetrazolium chloride. Frozen sections were incubated with enzyme glucose-6-phospate dehydrogenase (G6PD) substrate (D-glucose 6-phosphate (G6P)) across a grid of time and G6p concentration. FABP4 protein and gene expression was determined by immunohistochemistry and RT-qPCR, respectively. Additionally, FABP5 and GLUT1 were assessed by RT-qPCR in murine submandibular gland (SMG) tissue.

Results & Conclusions: We first tested the enzymatic assay to measure glucose metabolism in oral tissues at cGVHD onset. Time- and dose- dependent formazan formation, and consequently G6PD activity were observed. Abrogation of the staining in negative control (absence of substrate) confirmed the specificity of the approach. Decreased G6PD activity was measured in oral GVHD versus post-HSCT OM. Glucose transporter protein GLUT1 gene expression was also evaluated in whole SMG without significant differences between experimental groups. Regarding FA metabolism, immunofluorescence staining of both human and mouse SG showed localization of FABP4 in endothelial cells, as previously observed by our group by scRNAseq, but no correlation was observed between FABP4 expression and CD3+CD69+ T cell infiltration. SMG gene expression analysis of FABP4 and FABP5 showed no differences between experimental groups or timepoints.

Discussion: The metabolic imaging method used in this study allowed the measurement of enzymatic activity in cells in their intact microenvironment. Work is ongoing to determine the metabolic requirements of Trm in oral tissues and to assess their importance in oral cGVHD onset.

8"The response of dental pulp-derived cells to angiopoietin-like 4 in vitro"

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Introduction: Angiopoietin-like 4 (ANGPTL4) is an angiogenic protein modulated by hypoxia inducible factor (HIF)1α in response to cellular hypoxia in bone tissue. At high concentrations, ANGPTL4 leads to bone resorption, while at low concentrations it is associated with bone mineralization. ANGPTL4 is currently considered an "orphan ligand," as no cell receptor has yet been identified. Previous studies investigating the expression of ANGPTL4 in periodontal ligament fibroblasts (PDLF) and dental pulp cells showed an increase in production upon exposure to hypoxia, but substantial autocrine effects from exogenous exposure of PDLF to ANGPTL4 were not observed. The autocrine effects of ANGPTL4 on dental pulp cells have yet to be investigated.

Objectives: The aim of this study was to examine the effects of exogenous ANGPTL4 in full length, C- terminal, and N-terminal isoforms on human dental pulp cells in vitro.

Materials & Methods: Monolayer cultures of human dental pulp-derived cells were treated with recombinant ANGPTL4 full length, C-terminal, and N- terminal fragments at, 3, 10, 30, and 100 ng/mL in medium with serum. For the evaluation of alkaline phosphatase and matrix mineralization differentiation medium with serum was used. Viability and DNA synthesis were evaluated with an MTT assay and BrdU incorporation assay, respectively. Alkaline phosphatase and matrix mineralization were evaluated based on histochemical staining and alizarin staining, respectively. Staurosporine served as positive control for toxicity. Monolayer cultures were also treated with recombinant ANGPTL4 at 100 ng/mL in medium and serum and evaluated with MTT and Live/Dead staining. Experiments were performed twice with three different donors, respectively.

Results & Conclusions: Full length, C-terminal, and N-terminal fragments at 3, 10, 30, and 100 ng/mL did not substantially modulate viability, proliferation, osteogenic differentiation, and matrix mineralization in monolayer culture of human derived dental pulp cell. Furthermore, a high concentration of ANGPTL4 in all tested forms was not sufficient in inhibiting cell viability.

Discussion: The results of this experiment show that full-length, C-terminal, and N-terminal isoforms of angiopoietin-like 4 do not modulate cell proliferation or viability in human- derived dental pulp cells in vitro. It is unclear if dental pulp cells express a receptor for ANGTPL4. Future experiments will reveal if ANGPTL4 modulates other processes in these cells.

9"Investigating the Genetics of Non-Syndromic Cleft Lip and Palate with PCR and Whole-Exome Sequencing"

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Background: Orofacial clefts occur once in every 700 - 1000 births. Clefting anomalies are life-altering disorders with significant cosmetic effects that can affect parent-child bonding, self-esteem, and have significant impact on feeding, speech, hearing and dental health. Pinpointing causal genes has proven difficult due to the polygenic nature of non-syndromic cleft lip/palate (NSCL/P). Thus, our current understanding of NSCL/P genetics is insufficient to accurately predict these anomalies in utero. Understanding the specific genetic basis of NSCL/P could result in detection of these abnormalities prior to birth, allowing more time to prepare parents and physicians in efforts to reduce the negative effects of NSCL/P and the associated neurodevelopmental problems. Recent research has implicated mutations in the *FGF8* and *ESRP2* genes as likely pathogenic, but further study is needed to identify which mutations are important in orofacial clefts and in which populations those mutations are present.

Objectives: There were really three separate projects:
1. Isolate DNA from blood and saliva samples obtained on a 2019 cleft lip/palate surgical trip to Neiva, Colombia.
2. Select 25 trios from our database (which contains samples from the 2019, as well as past, surgical trips) whose NSCL/P shows strong genetic etiology in pedigree review. Isolate their DNA samples and send for whole-exome sequencing (WES).
3. Select 20 singletons from our database whose NSCL/P shows strong genetic etiology in pedigree review. Use polymerase chain reaction (PCR) to amplify *fgf8* and *esrp2*. Send for sequencing and identify mutations.

Materials & Methods: Samples selected for WES were sent to the Broad Institute. Samples selected for PCR were prepared by diluting each subjects' DNA sample to 50ng/uL. Primers for each exon of interest were diluted to 100 uL and a concentration of 10uM. 25 uL master mixtures were then prepared for each primer/sample combination. The mixtures included: 5uL buffer, 5uL dNTPs, 2 uL Taq polymerase, 0.5uL of forward primer, 0.5uL of reverse primer, 1uL of proband DNA sample and 12.8uL water. If the primer sequence required, 5uL of GC primer were also added and 5 fewer uL of water were added. A control PCR containing non-subject DNA was run with each primer. Following PCR, samples were run on a 1.5% agarose gel and visualized using a UV box to confirm the successful amplification. Samples and primers were then sent to GeneWiz for Sanger sequencing. Sequences were assessed for any mutations in the *fgf8* and *esrp2* genes.

Results and Conclusions: Early analysis of the 25 trios that underwent WES found the following: in analysis of 8 cases of bilateral cleft lip/palate, de novo rare variants were found in 3 separate genes (NDST1, ROR2, and ZNF462). The sequences of the 20 singleton's *fgf8* and *esrp2* genes were studied; only one missense variant was found.

Discussion: Our findings (or lack thereof) in the PCR arm of the study were to be expected: the odds of finding a variant in one of two genes in such a small sample size were very low. However, it is disappointing that this initial investigation into two genes previously believed to be of some significance yielded no results. Previous studies suggested NDST1, ROR2 and ZNF462 may play roles in craniofacial developmental abnormalities. Our initial findings corroborate these reports. We eagerly await additional analysis of the WES data.

10 "Cross-Sectional Description of Motor Phenotypes Related to KIF1A Gene Mutations"

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Background: KIF1A is a molecular motor protein that is part of the kinesin family. Mutations in *KIF1A*, both heritable and *de novo,* result in a progressive neurodegenerative condition, commonly affecting children, known as *KIF1A* Associated Neurological Disorder (KAND). KAND is characterized by cognitive impairment, cerebellar atrophy, optic nerve atrophy, spastic paraplegia, and often epilepsy. Currently, there are 200 individuals diagnosed with KAND. Understanding how *KIF1A* mutations result in these neurological phenotypes can help provide insight for future treatment.

Objectives: The goal of this research is to better define the motor skills in individuals with KAND by preforming cross-sectional description of motor skills related to the mutation and correlating genotype with phenotype. Motor phenotype was assessed with cross sectional caregiver reported questionnaires.

Materials & methods: This study includes 38 individuals assessed an average age of 10.7 years. Of these 38 individuals, 25 have mutations within the microtubule binding region of the KIF1A proteins, and 13 individuals have mutations within the non-microtubule binding region of the KIF1A protein. The 'motor' section of the Vineland Adaptive Behavior Scales-II (VABS-II) was administered by interview. We directly compared the adaptive behavior composite score (ABC), a composite score representative of daily life functional skills, to the motor skills standard score of the VABS-II. The motor skills domain was broken down further into gross and fine motor subdomains.

Results: Across the 38 individuals all ABC and motor skills standard scores were below 100, the mean in the normal population. The average ABC score for the total cohort was found to be 56.7 and the average composite motor score was found to be 57.0; the average motor score was 3.5 standard deviations below the mean. When looking at mutation specific regions the average ABC composite score in individuals with mutations in the binding region had a score of 55.0 where individuals with mutations in the non-binding region had an ABC score of 59.9. When looking at the average motor composite score in individuals with mutations in the binding region they had a score of 53.2 while individuals with mutations in the non-binding region had a motor score of 64.4. This supports that Individuals with mutations in the microtubule binding region show more severe motor deficits than individuals with mutations in the non-binding region. Overall, these individuals have below average ABC and composite motor skills scores when compared to the normal population suggesting that individuals with KAND have significant deficits in age expected skills.

Conclusions: KIF1A Associated Neurologic Disorder (KAND) is a rare genetic neurodegenerative disease, commonly affecting children. These cross-sectional results will provide the baseline for comparison for longitudinal studies to describe the natural history, against which future treatments can be compared.

11 "The Role of Car3 in the Protection of Intestinal Epithelial Cells Against Oxidative Injury"

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Introduction: Reactive Oxygen Species (ROS; H_2O_2, O_2- and $OH\cdot$) are the main cause of inflammation mediated oxidative damage in inflammatory bowel disease. It has been shown in mice with induced chemical colitis that insulin treatment decreases damage associated with the disease. A proposed mechanism of this therapeutic effect is insulin mediated upregulation of carbonic anhydrase 3 (Car3), a protein whose function has not been well characterized in intestinal epithelial cells (IEC). To further understand how Car3 plays a role in insulin treatment, it is necessary to investigate how ROS affect IEC with and without induced Car3 expression.

Objectives: We hypothesized that LS174T colon carcinoma cells, a model for IEC, expressing Car3 under a tetracycline induced promoter (LS147T/doxy+) will show an increased survival in the oxidative environment compared to control cells.

Materials and Methods: An MTT assay was used to measure survival and maturation after oxidative damage. The linear detection range of the MTT assay was determined with LS147T/doxy- and Caco2 cell lines. Oxidative damage was induced by addition of 100-750uM of hydrogen peroxide over 16 hours to the cells. 20E3 of LS147T/doxy- and Caco2 cells were plated on the MTT assay. In an additional MTT assay, 2.5E3, 5E3, 10E3 LS147T/doxy- cells were plated. Western blot analysis and PCR were used to measure levels of Car3 expression in undifferentiated Caco2 (uCaco2) cells, differentiated Caco2 cells (dCaco2), and Caco2 cells with induced doxycycline expression (Caco2/doxy+) at 1mg/mL and 3mg/mL.

Results and Conclusions: A significant difference was observed in MTT assay absorbance measurements for Caco2 cells treated with different concentrations of hydrogen peroxide. There was no significant difference seen in the absorbance measurements for the LS147T/doxy- cell line when 20E3 cells were plated but significant differences when 2.5E3, 5E3, and 10E3 cells were plated. In all Caco2 PCR runs, there was an independent increase in Car3 in dCaco2 cells compared to uCaco2 cells by around 3 fold. Both western blots comparing dCaco-2 cells to uCaco2 cells and Caco2/doxy+ cells to controls only showed positive control bands upon imaging. All experimental lanes were negative.

Discussion: Understanding the role of Car3 in IEC may provide new treatment options for patients with inflammatory bowel diseases. Our findings showed that there seems to be an increase in Car3 expression in dCaco2 compared to uCaco2 cells, but the level is too low for Western blot detection. Results were inconclusive for whether there was an increase in Car3 in the Caco2/doxy+ system. We were unable to test the effects of oxidative damage on LS147T/doxy+ cells using our MTT assay due to the delay in receiving these cells from another lab. It thus remains unclear whether LS147T cells with doxy induced Car3 expression will show increased survival in the oxidative environment compared to control cells. It also remains unclear how Car3 interacts with the insulin receptor in IEC, and whether this plays a deterministic role in the course of colitis. In order to answer this question, it is first necessary to test the effects of oxidative treatment on IEC with induced Car3 expression to see whether there is a direct link between Car3 and its proposed effects on decreasing oxidative damage.

12 "Effects of transplacental *Fusobacterium nucleatum* infection in the postnatal neurological health of offspring"

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Background: *Fusobacterium nucleatum* is a Gram-negative anaerobic bacterium commonly found within the oral cavity and closely associated with periodontal disease. *F. nucleatum* is capable of spreading systemically to extra-oral sites and has thus been implicated in a wide spectrum of human diseases including GI disorders and adverse pregnancy outcomes such as preterm birth and neonatal sepsis. Although *F. nucleatum* is one of the few organisms that can cross both placental and blood-brain barriers, no studies have been conducted to assess the postnatal neurological health of mice exposed to transplacental infection.

Objectives: We aimed to investigate the effects of transplacental *F. nucleatum* infection on the developing mouse brain through neurobehavioral tests of the offsprings.

Materials & Methods: Pregnant mice were infected with 100ul of 1×10^7-5×10^7 cfu of *F. nucleatum* via tail-vein injection. The offsprings born to *F. nucleatum* infected mothers and age-match controls mice were subjected to a series of behavioral tests – The Righting Reflex at 1- and 2-weeks of age to assess motor strength and coordination at early developmental ages, and Rotarod, Open Field, and Catwalk at 3-month and 6-month of age to assess neuromuscular function and learning ability.

Results & Conclusions: Compared to the controls, mice born to mothers infected with *F. nucleatum* showed significant changes in neuromotor functions, as assessed by the Righting Reflex test ($p < 0.001$) at one week, and by Catwalk swing speed ($p < 0.01$) at three months. They were also defective in learning ability in Rotarod test at three ($p < 0.05$) and six months ($p < 0.001$) of age and in Open Field test at three months ($0 < 0.001$).

Discussion: Through the exhibited behavioral changes reflecting learning ability and neuromotor function, we discover for the first time a neurological effect of transplacental *F. nucleatum* infection on the offspring. Our findings show that behavioral differences are especially significant during the early stages of development. These findings are consistent with previous epidemiological studies that intrauterine infection may impact neurodevelopment and increase the risk for CNS disorders such as cerebral palsy and autism. Further research will be conducted by analyzing brain tissue harvested from the offspring mice to examine the possible presence of *F. nucleatum* and *Fusobacterium* adhesin FadA.

13"Periodontal Disease Prevalence in HIV Infected Women in New York City"

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Introduction: Quality of life of People living with HIV (PLWH) has increased significantly with the advent of combination antiretroviral therapy (cART) due to successful suppression of viremia and restoration of CD4+ T-cells. Still, people living with HIV are more subject to aging-related non-communicable inflammatory diseases than patients without HIV. Examples of these diseases include diabetes. HIV infection and diabetes have been both identified as risk factors for periodontal disease, therefore, PLWH with diabetes may be more prone to periodontal disease.

Material and Methods: Participants underwent a full-mouth periodontal examination determining probing depth (PD), clinical attachment level (CAL), and bleeding on probing (BOP) and were stratified by their self-reported diabetes status. In addition, we also looked at their current smoking status because it is a known risk factor for periodontal disease. Periodontal status was classified according to the Center for Disease Control and Prevention/American Academy of Periodontology (CDC/AAP) in population-based surveillance. Full mouth series dental x-rays were performed to determine the alveolar crest height (ACH) (cemento-enamel junction to alveolar crest).

Results and Conclusions: 83 percent of our subjects had periodontitis, either in its severe or moderate form. PLWH who smoked had a significant increase in mean probing depths compared to PLWH who do not smoke. Surprisingly, PLWH with diabetes had less mean CAL than PLWH without diabetes.

Discussion: It may be possible that HIV infection in women promotes periodontal disease to such an extent that other known risk factors such as diabetes status do not cause further aggravation. We are currently recruiting control subjects (HIV uninfected women) from similar ethnic backgrounds and socioeconomic statuses in order to compare periodontal status among similarly aged groups. Analysis of the control subjects' data would allow us to determine whether periodontal disease in PLWH is a result of factors such as ethnicity and lower socioeconomic status or truly an outcome of HIV infection. If periodontal disease is not similar in PLWH and control groups, then further research efforts can focus on measures to improve periodontal status in PLWH regardless of smoking and diabetic status.

14"Investigation of the Mechanism of CTGF-Induced Migration of Synovial/Mesenchymal Stem Cells"

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Introduction: Temporomandibular joint (TMJ) degenerative disorders affect millions of Americans of each year, promoting myofascial pain and discomfort without effective, evidence-based treatment. Contemporary treatment for TMJ disorders include invasive surgery and artificial TMJ implants that have not established a reliable, pain-free outcome or simple symptom relief-based treatment. Our research group has been investigating the application of tissue engineering and regenerative medicine to enhance recruitment of endogenous synovial mesenchymal stem/progenitor cells (syMSC) into 3D-printed scaffolds embedded with connective tissue growth factor (CTGF) and to study its underlying mechanism.

Objectives: Our aims were 1) to confirm CTGF as a chemotactic agent to induce syMSC migration, 2) to determine surface proteins/potential receptors involved in cellular migration (CD44), and 3) to quantify a 3D migration assay to determine the underlying mechanism of syMSC migration.

Materials/Methods: We fabricated 3D-printed scaffolds (5x5x5 mm) embedded with poly(lactic-co-glycolic acid) (PLGA) microspheres encapsulated with CTGF or PBS as a negative control. Collagen gel was subsequently infused into the scaffold microchannels, followed by plating syMSCs on the top of scaffolds. By 1 and 2 wks, the number of migrated cells were quantified using DAPI staining and two-photon confocal microscopy. Multiple slices images in 15 µm intervals were reconstructed into 3D images and the migrated cells were quantified in the 10 randomly selected area (300 X 300 µm) of interest each group. In addition, the role of CD44 was investigated alongside CTGF-induced recruitment by utilizing antibody-based blocking.

Results: In vitro cell migration assay displayed a significant increase in the number of cells that migrated up to 60 µm distance from baseline in CTGF-releasing scaffolds in comparison to scaffolds with empty PLGA microspheres by 1 and 2 wks. There was a significantly higher amount of cells observed migrating away from baseline when observed for two weeks as opposed to one. In addition, blocking surface CD44 significantly reduced the number of migrated cells, suggesting that CD44 has a role associated with cellular migration.

Discussion: Our findings suggest the important roles of CD44 in CTGF-directed migration of syMSCs into 3D-printed scaffolds. The limitations of this study include potential role of CTGF in promotion of cell proliferation. In conclusion, the present study has implication in mechanism of CTGF-guided stem cell recruitment toward in situ regeneration of craniofacial tissues.

15 "Dual-Crosslinked Gelatin to Facilitate Stem Cell-Guided Fibrocartilage Healing"

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Introduction: Various bio-glues have been tested to facilitate stem cell-based healing of fibrocartilaginous tissues such as the temporomandibular joint (TMJ) disc and knee meniscus. Outstanding challenges in bio-glues include poor wet-bonding adhesion and mechanical strength. To overcome these weaknesses, we developed a dual-crosslinked gelatin with methacrylate and dopamine and tested its efficacy in our stem cell-guided fibrocartilage healing model.

Objectives: The goal of this study was to investigate the mechanical and regenerative properties of a gelatin-derived bioglue double conjugated with methacrylate and dopamine for increased adhesive strength and to ensure its delivery of stem cell-recruiting growth factors to sites of torn fibrocartilaginous avascular menisci.

Materials & Methods: Methacrylated (Gel-MA) and further dopamine-conjugated (Gel-MA-DOPA) gelatin were synthesized per established protocols. A series of fibrin, Fe^{3+} and ultraviolet (UV)/visible light photo-initiator concentrations were tested to optimize adhesion and mechanical stability by lap shear and compression tests. Our synthesized bio-glue was loaded with connective tissue growth factor (CTGF) (100-ng/ml) and transforming growth factor-beta 3 (TGF-β3) encapsulated poly(glycolide-co-lactide) (PLGA) microspheres (10-mg) and applied for healing of an incision made at the avascular inner third zone of bovine meniscus, cultured with human bone marrow-derived mesenchymal stem/progenitor cells (hBM-MSCs) in fibrochondrogenic supplements. At 3-wk, harvested explants were analyzed.

Results & Conclusion: Gel-MA-DOPA with Fe^{3+} or Fibrin showed successful instant gelation. UV-exposed gels exhibited significantly higher ($p<0.05$) lap shear moduli and strength when compared to gels that did not receive UV-exposure. Under UV exposure, Gel-MA-DOPA exhibited significantly higher compressive modulus and strength than Gel-MA. Overall, Gel-MA-DOPA displayed superior mechanical properties to Gel-MA. After culturing for 3-wk with hBM-MSCs in fibrochondrogenic supplements, the meniscus explants with growth factor-loaded Gel-MA-DOPA showed significantly higher tensile moduli (322.78±101.37 kPa) and strength (58.31±22.61 kPa) compared to Gel-MA alone. Application of Gel-MA-DOPA significantly improved healing of avascular menisci regions through increased integration of fibrocartilaginous tissues.

Discussion: Gel-MA-DOPA demonstrated instant gelation via reversible chelation making our bioglue easy-to-use. Gel-MA-DOPA exhibited enhanced tissue integration most likely via irreversible covalent bonds with tissue upon catechol to quinone oxidation. Follow-up studies will investigate gluing mechanisms, refinement processes to improve gel mechanics, and long-term outcomes. In conclusion, the dual-crosslinked bio-glue conjugated with dopamine and methacrylate, Gel-MA-DOPA, may serve as a novel, efficient tissue adhesive vehicle for stem cell-guided healing of fibrocartilaginous tissues including meniscus and TMJ discs.

16"The Effects of Algae Superfoods on Cell Viability of Oral Tissues"

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Background: The microalgae *Chlorella vulgaris* and the cyanobacteria *Spirulina platensis* are marine algae superfoods that have risen in popularity due to their nutritional quality and potential role in wound healing and antioxidant activities. Previous studies have shown the efficacy of locally delivered spirulina gel as adjunct therapy in the treatment of chronic periodontitis. This research expands upon our understanding of how Chlorella and Spirulina algae treatment impacts oral tissues.

Objectives: We aimed to study the effects of Chlorella and Spirulina powder extract and conditioned media (CM) treatments on the viability, proliferation, and metabolism of human dental pulp cells (DPC), gingival fibroblast cells (GF), and periodontal ligament fibroblast (PDLF) cells.

Materials & Methods: 30 mg/ml *Chlorella vulgaris* or *Spirulina platensis* was dissolved in αMEM supplemented with 1% Penicillin/Streptomycin. Powder extracts were aliquoted or filtered through a 0.22μm sterile filter to create CM. Desired cells (DPC, GF, PDLF) were stimulated with desired algae concentrations. MTT and AlamarBlue assays measured cell viability of cultures stimulated with different concentrations of algae powder extract or CM. The highest algae concentration (3.75 mg/ml) that demonstrated cell viability was selected for LIVE/DEAD assay and MTT staining. Cell culture media was collected and ELISA was performed to measure levels of VEGF, IL-6, and IL-8.

Results and Conclusions: MTT assay results indicated that cell metabolic activity was higher in cultures treated with chlorella and spirulina CM compared to those treated with powder extracts. AlamarBlue assay results indicated cell metabolic activity increased with decreasing algae concentration. The highest algae concentration that produced viable cells was 3.75 mg/ml. LIVE/DEAD assay and MTT staining showed cell viability only in the oral cells treated with 3.75 mg/ml Chlorella CM. ELISA results showed that there was an upregulation of IL-6 and IL-8 in cell cultures treated with Chlorella CM.

Discussion: Our findings showed that treatment with Chlorella CM exhibited less cytotoxicity to DPC, GF, and PDLF cells compared to other forms of algae treatment. We created a dose response curve and identified the highest dose that produced viable cells (3.75 mg/mL). We found that Chlorella CM may increase the expression of certain chemokines, such as IL-6 and IL-8. These results have implications for the formulation and effects of algae with regards to its potential use as a therapeutic agent in treating oral disease. Further research is required to better understand the impacts of Chlorella and Spirulina on inflammation in oral tissues.

17 "Epigenome Editing for Endogenous Activation of Periodontal and Tendon Transcription Factors"

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Background: Severe periodontitis is the sixth prevalent medical condition globally. In addition, tendon accounts for approximately half of the US 33 million musculoskeletal injuries. Current treatments fail to restore these tissues back to their native state. Regeneration with stem cells is an attractive approach however, proper lineage programming is elusive and will likely require transcriptional gene network regulation to generate homogenous populations. Transcription factors Scleraxis (SCX) and Mohawk (MKX) are essential in periodontal ligament and tendon development. We take a multiplexed approach to precisely target and endogenously activate both regulators using genomic epigenetic editing with a dCas9 CRISPR activation system.

Objectives: We hypothesize that endogenous activation of key transcriptional factors, SCX and MKX, will consequently activate downstream lineage pathways toward periodontal & tenogenic differentiation and repair.

Materials & Methods: CRISPRa components included Sp-dCas9 fused with transcriptional activator VPR and four guide RNAs (gRNA) per gene. Multiple gRNAs were designed targeting the promoter region of MKX or SCX. Transfection efficiency and gene upregulation was tested with HEK-293T cells, followed by efficiency on human mesenchymal (BM-MSC) and dental pulp (DPSCs) stem/progenitor cells. Cells were co-transfected with 200 ng of dCas9-VPR and 10-100 ng of gRNA. Samples were harvested at 24/48 hours, total RNA isolated with 1µg for cDNA. SCX and MKX expression was evaluated with qPCR using GAPDH as the endogenous control.

Results and Conclusions: Transfection efficiency of HEK-293T cells was >80%. dCas9-VPR activation achieved sustained and increased gene expression at 24 and 48 hours. Screening identified the best performing gRNAs for SCX and MKX, which produced a 141 and 4.4 fold increase respectively. Best performing gRNAs were then applied individually and multiplexed to achieve endogenous activation of both transcription factors. Within 48 hours, the multiplexed gRNAs achieved endogenous activation of SCX and MKX concurrently up to ~43 fold and ~4 fold respectively. To improve MKX upregulation, we applied increasing gRNA concentrations from 10 to 100 ng. This significantly improved efficiency up to >90% and led to a 10 fold increase in expression, suggesting a modular capability of our epigenetic activators.

Discussion: We established a protocol to epigenetically edit periodontal and tendon regulators using a CRISPRa dCas9-VPR system. We identified standout gRNAs for robust activation and efficient transfection conditions for HEK-293T, BM-MSC and DPSCs. This transcriptional engineering approach for endogenous regulation of multiple genes simultaneously may lead to enhanced stem cell programming and ultimately stimulate periodontal ligament and tendon repair.

18"The Role of Midkine in Head and Neck Cancer"

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Background: Head and neck cancer (HNC) accounts for more than 300,000 deaths annually worldwide. Midkine (MK), a heparin-binding growth factor, is strongly expressed during the fetal period. At birth and throughout life, MK expression is low and restricted to certain tissues. In states of inflammation and injury, however, MK is over-expressed and may be involved in tumorigenesis. A better understanding of the molecular players involved in head and neck cancer such as MK will help in the development of novel targeted therapies.

Objectives: We hypothesized that MK is over-expressed in HNC tumors and this increase plays a role in the pathogenesis of HNC.

Materials & Methods: We investigated the expression of MK in The Cancer Genome Atlas (TCGA) and assessed its association with different covariates such as tumor grade, metastasis, HPV status, and alcohol use. HNC cell lines were challenged with alcohol (50mM) and checked for MK expression levels. An HNC cell line (HTB-43) was treated with recombinant MK to investigate the mechanistic role of MK signaling. Real-time PCR was used to quantify relative mRNA expression. Comprehensive mRNA profiling was done using a Clarium S assay. Differential gene expression and pathway analysis were conducted using R software. P-value of less than 0.05 was considered statistically significant.

Results and Conclusions: MK expression increased significantly in tumor tissue compared to normal adjacent tissue in TCGA samples ($p<0.05$). Grade 3 and 4 tumors showed significantly increased levels of MK ($p<0.05$). MK expression was higher in HPV-positive cases and alcohol users compared to HPV-negative cases and non-alcohol users, respectively ($p<0.05$). Alcohol challenge of HTB-43 showed a significant increase in MK expression at the mRNA and protein level ($p<0.05$). Genes involved in tumor metastasis, angiogenesis, and immune escape (CERS3, LY6D MMP3/10, S100A9) were up-regulated after MK treatment in a HNC cell line (FADU) while cell cycle and immune system regulatory genes (LCK, MYADM, CCND2, CDCA7L) were down-regulated. These findings demonstrate that MK plays a role in head and neck cancer.

Discussion: High MK expression levels in head and neck cancer must be involved in the pathogenesis of these tumors. Genes found to be up/down-regulated after MK treatment will help us better understand MK's implications in normal cellular processes and involvement in pathologic states. Overall, our findings suggest inhibition of MK in head and neck cancer may have therapeutic effects in targeted therapy, although further investigation is needed before applying MK to the clinical setting.

19"Optimization of AlphaLisa Assay for Aggrecan Detection During TMJ Fibrocartilage Stem Cell (FCSC) Differentiation"

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Background: The temporomandibular joint (TMJ) is critical for movements of the jaw and activities such as speaking and eating. In TMJ disorders, the articular disc and/or joint undergoes degeneration/displacement, which significantly impairs normal functioning, causes pain, and decreases quality of life. Despite the complex etiology and prevalence of TMJ disorders, it remains greatly understudied and poorly understood. No predictable form of treatment exists, with care primarily being palliative or surgical. In addition, stem cell transplantation for regeneration comes with its own set of challenges such as immune rejection and engraftment. Consequently, identifying a therapeutic compound that can induce differentiation of endogenous FCSCs into chondrocytes for cartilage formation is a promising approach for future treatment, that may overcome existing barriers with stem cell-based therapy in the area.

Objectives: The Embree Lab has previously shown that intra-articular injections containing the Wnt inhibitor sclerostin induces endogenous FCSCs to regenerate cartilage in a rabbit TMJ-injury model. This project aims to further explore the therapeutic potential of this FCSC population by identifying approved drugs/small molecules that can be repurposed as TMJ fibrocartilage regenerative therapies. Immediate aims of this study are to 1) Develop an in-vitro phenotypic screen to quantify the differentiation of TMJ FCSCs using AlphaLISA for aggrecan; and 2) Submit protocol to the Columbia Genome Center for high throughput screening (HTS) analysis against clinical compound libraries to test potential candidates.

Materials & Methods: Rat FCSCs and bone marrow stromal cells (BMSCs) previously isolated by Dr. Embree's lab were cultured and plated at a specified density in 384 well plates, incubated for the appropriate time in (20% FBS) media, and then serum starved overnight (in 2% FBS Media). To induce differentiation in positive controls, FCSCs were treated with the potent chondrogenic factor TGF-β1. After 2-3 days FCSCs were lysed. Then, the Ab pairs were formulated into various dilutions and added to the lysate. Lastly, acceptor beads were added, followed by the donor beads. Final plate sent for HTS analysis.

Results and Conclusions: The Ab's for aggrecan recognition and Ab pairs for donor and acceptor beads necessary for the AlphaLisa screen have been determined - BC3 (mouse aggrecan monoclonal Ab) for the donor beads and AB1031 (rabbit anti aggrecan polyclonal Ab) for the acceptor beads. Preliminary experiments have been run and analyzed by the HTS facility. The 250:5000 dilution exhibited the greatest fold change in signal-to-noise, and thus aggrecan expression/FCSC differentiation.

Discussion: Our initial findings indicate that AlphaLisa is a promising method for identifying drug candidates that can induce FCSC differentiation. However, further research is needed to increase the signal-to-background ratio of the screen. Once achieved, we can proceed with submitting the protocol to the HTS facility to test against clinical compound libraries. When potential candidates are identified, they would require in vitro validation via RT-qPCR, dose response testing to examine effects on cell proliferation and viability, differentiation assays in vivo, pre-clinical model testing in a pig, and finally human clinical trials.

20 "Cartilage Regeneration from Stem/Progenitor Cells Through Immunomodulation"

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Introduction : Osteoarthritis (OA) is the most prevalent degenerative joint disorder affecting millions of patients worldwide. OA can affect many joints including the temporomandibular joint (TMJ). Stress exerted by mechanical loading and the associated elevation of pro-inflammatory and catabolic cytokines largely contribute to the disruption of cartilage homeostasis, consequently resulting in cartilage degeneration. Various tissue engineering approaches, with scaffolds, stem cells, and/or bioactive cues, have been applied to improve cartilage healing and/or repair that resulted in some promising in vivo outcomes. Despite the notable advances in regenerative strategies and surgical technique, clinical success in regeneration of damaged cartilage remains unsatisfactory, especially under pathological conditions. The pro-inflammatory responses are the major pathological features in the joints with OA, and thus needs to be considered for successful translation of cartilage regeneration strategies.

Objectives: This study is designed to investigate the effects of selected pro-inflammatory cytokine, anti-inflammatory and chondrogenic small molecules in stem/progenitor cells derived cartilage tissue engineering. The objective of this work is to make a tissue engineered immunoresponsive system that can simultaneously modulate deleterious inflammation and guide stem/progenitor cells' differentiation to regenerate functional cartilage.

Materials and Methods: AF12198, a small peptide molecule that acts as IL-1 receptors antagonist (IL-1Ra), and kartogenin (KGN), a chondrogenic small molecule were used in this study. P3-P4 hBMSCs (human bone marrow derived mesenchymal stem/progenitor cells) and hCCs (human chondrocyte cells) were plated and treated with IL-1Ra (1-4 µM), KGN (10-80 µM), and IL-1Ra+KGN (1-4 µM+10-80 µM) for live-dead cell assay to examine KGN and IL-1Ra toxicity at different concentrations. hBMSCs and hCCs were also treated with IL-1Ra+KGN (1-4 µM+10-80 µM) in presence of pro-inflammatory cytokine, IL-1β, to determine optimum dosage needed for inflammation prevention and cartilage regeneration simultaneously. mRNA expression of IL-1β, TNFα, IL-6, IL-10, MMP-3, COL-II, SOX9, and aggrecan (ACAN) was measured by real-time qPCR.

Results and Conclusions: Live-dead cell assays showed that AF12198 and KGN were well tolerated by both hBMSCs and chondrocyte cells at high concentrations (4 µM, 80 µM, respectively). mRNA analysis indicated reduced TNFα, IL-6, and MMP-3 expression in hBMSCs and reduced IL-6, and MMP-3 expression in hCCs. Cartilage-promoting SOX9 expression was significantly increased in both cell lines at this same dose. In conclusion, the combined application of AF12198 and KGN may have implication in cartilage repair/regeneration in osteoarthritic inflammatory joints.

Discussion: Our findings suggest that the dose of IL-1Ra + KGN (4 µM + 80 µM) is promising for cartilage regeneration through immunomodulation. Future studies will investigate cartilage specific matrix formation in 3D culture, and how controlled delivery of these small molecules can modulate the inflammation to promote cartilage regeneration as well.

21"Development of Injectable Hyaluronic Acid-Sclerostin Hydrogel to Ameliorate TMJ Osteoarthritis"

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Background: TMJ osteoarthritis is a subset of TMJ trauma and degenerative diseases that is debilitating and decreases quality of life. Current treatment for the 10 million Americans afflicted are limited to palliative care or invasive surgery. There is a need for a minimally invasive stem cell-based therapy that will repair and regenerate fibrocartilage tissue to ameliorate TMJ OA. Sclerostin is a Wnt inhibitor that maintains fibrocartilage stem cell pool in the condyle, and can be delivered locally via hydrogel to TMJ OA patients to repair and regenerate TMJ tissue.

Objectives: Sustained release of Sclerostin from high molecular weight hyaluronic acid hydrogel (HMW HA-Sclerostin) will induce chondrogenic differentiation of fibrocartilage stem cells, and monthly intra-articular injections will promote cartilage regeneration to ameliorate TMJ OA in rabbits.

Materials & Methods: Recombinant Sclerostin was mixed in 2% HMW-HA, 2% LMW, and 3% LMW HA. Sclerostin was placed in permeable Transwells for sustained release, and concentration over six weeks was measured using ELISA. A differentiation assay of cartilage (Acan), bone (Runx2), Wnt (Axin2, Wnt3a), and inflammatory markers (TNFα, IL1β) was conducted by qrt-PCR. Additionally, TMJ disc and condyle were analyzed after TMJ induced injury model and administration of HA-Sclerostin therapy.

Results and Conclusions: A cumulative sustained release curve of Sclerostin shows 2% HMW-HA sustained release of Sclerostin. Fibrocartilage stem cells exposed to HA-Sclerostin show an increase in cartilage-related expression of Aggrecan relative to controls and similar to recombinant Sclerostin protein. HA-Sclerostin hydrogel did not induce inflammatory markers TNFα and IL1β. Rabbits that received HA-Sclerostin injection therapy showed fewer signs of osteoarthritis (clefting, acellular areas, chondrocyte clustering).

Discussion: Localized delivery of Sclerostin via HMW-HA hydrogel promotes chondrogenic differentiation of fibrocartilage stem cells to regenerate the TMJ. HA-hydrogels are currently FDA approved for knee OA, and this investigation supports a similar treatment modality for TMJ OA. This fulfills the need for a minimally invasive TMJ therapy that targets pathological mechanisms and promotes tissue regeneration. Future investigations include additional TMJ injury model trials and optimizing local delivery of Sclerostin to modify fibrocartilage stem cells to regenerate TMJ using Yucatan miniature pigs as large-scale animal models.

22 "Ophthalmic Manifestations of *KIF1A* Associated Neurological Disorder"

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Background: *KIF1A* is part of the kinesin family that is responsible for the anterograde transport of organelles along neuronal axons. Mutations in *KIF1A* are associated with KIF1A Associated Neurological Disorder (KAND), an early onset neurodegenerative disorder. KAND is associated with developmental delay/intellectual disabilities, cognitive impairment, ataxia, cerebral atrophy, spastic paraparesis, optic nerve atrophy, peripheral neuropathy, and epilepsy. Different mutations are associated with different phenotypes and disease severity. One component of the phenotype that can have a significant impact on patient and family quality of life is ophthalmic. Previous research has shown there is an increased prevalence of ophthalmic manifestations, with optic nerve atrophy the most common. To date, there has not been a comprehensive review of the vision issues seen in KAND.

Objectives: We hypothesized that there is a difference in KAND disease severity in those with ophthalmic manifestations compared to those without.

Materials & Methods: Written consent was obtained from 84 individuals with KAND, and studies were approved by the Columbia IRB. Data were collected by parental report, with primary record verification when available. Data collected included caregiver reported medical history, clinical genetic test reports, and Vineland Adaptive Behavior Scales-III. The Vineland Adaptive behavior scale is a measure of adaptive behavior that is widely used to assess individuals with intellectual, developmental, and other disabilities. The parent caregiver form assesses home and family-life behavior using a questionnaire completed by a parent or caregiver electronically. The ABC (adaptive behavior composite score) has three components: communication, daily living skills, and socialization. The score for each is expressed as a standard score with a mean of 100 and standard deviation of 15.

Results and Conclusions: The cohort of 84 individuals with KAND were divided into 4 subgroups: group 1 (15.5%) those whose eyes or visions are not affected, group 2 (10.7%) individuals with only common vision issues (myopia, astigmatism), group 3 (47.6%) individuals with other eye conditions (*amblyopia, cataract, conjunctival abnormality, cortical blindness, depth perception problems, eye movement abnormalities, glaucoma, nystagmus, optic nerve atrophy, ptosis, retinal detachment, strabismus*, not including common vision issues), and group 4 (26.2%) those with both common vision issues and other eye conditions. Using the Vineland III ABC score as a proxy for disease severity, there was a statistically significant difference in ABC score for the groups of ophthalmic manifestations (p=.001, F=5.65, Fcrit= 2.73). Compared to the CDC percentage of children (ages 6-17) who have common vision problems, our cohort is comparable to the general population for frequency of common vision problems.

Discussion: Our results suggests that *KIF1A* does not increase the prevalence of common vision problems but has a higher prevalence of other eye conditions. There is an increased prevalence of ophthalmic manifestations in those who are more severely developmentally affected. There was a statistically significant difference (p=.001) in the average ABC score by ophthalmic manifestation groups.

23"In vitro test of sealing of root filled canals"

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Introduction: Endodontic therapy is performed to save a tooth by preventing or eliminating root canal infection (Strindberg 1956, Sjögren et al 1990). However, root fillings that have been exposed for a length of time to the oral flora can show a penetration of bacteria between the root filling and canal walls (Madison and Wilcox 1988, Torabinejad et al 1990, Saunders and Saunders 1994, Tidswell et al 1994). This means that the sealing ability of the restoration of the tooth is important and to obtain a good outcome following endodontic therapy both the root filling and the restoration must be of good quality (Kirkevang et al 2000). Prior to the restoration of a root filled tooth a temporary filling is placed to keep oral cavity microorganisms out, but it has been shown that also temporary fillings can leak (Anderson et al 1988). It would be beneficial to have a material that can be placed at the orifice of a root filled canal to prevent bacterial exposure. Many materials can be used for sealing purposes, but combinations of nitrocellulose and alcohol-acetates have been shown to seal even when used in small volumes.

Objective: Testing the potential of nitrocellulose-butyl acetate gel as a coronal root canal filling protection on prepared teeth in a pilot study.

Materials & Methods: 20 extracted teeth with 42 root canals were used for the study. The teeth were extracted for periodontal or orthodontic reasons and were collected from clinics. Before preparation all teeth were placed for 24 hours in 5% sodium hypochlorite to remove surface soft tissue and concretions. Access cavities were prepared, and the most coronal millimeters of the root canals were widened with a #2 round bur in a slow speed hand piece. Pieces of cotton pellets were placed between the coronally widened and the untouched parts of the root canal. The nitrocellulose-butyl acetate gel was placed in the coronal small cavities with microbrushes. After the setting of the nitrocellulose-butyl acetate gel the access cavities were filled with India ink (Higgins, Chartpak Inc, Leeds, MA). The teeth were then kept in 100% humidity for three days. After that the teeth were placed in a 4% nitric acid solution for two days followed by one day in water. The teeth were then immersed in ascending grades of alcohol (70-96%) before being placed in methyl salicylate to make them transparent. The teeth were examined using a Zeiss clinical microscope.

Results & Conclusions: Under the present in vitro conditions the nitrocellulose-butyl acetate gel sealed all canals from leakage.

Discussion: Leakage studies are a way to evaluate if a material will seal. The studies can be performed in different ways and there is no gold standard for evaluation of sealing ability (Goldman et al 1989, Wu and Wesselink 1993). The present method was chosen as it is simple and gives the possibility of evaluating the leakage in three dimensions. A simple way of sealing a root filled canal after completed therapy would increase the chance for a successful outcome. It is not uncommon that patients don't get an appointment for restoration immediately after finished root canal treatment. This may be due to financial concerns, lack of time or sometimes not understanding the importance of finishing treatment even if the tooth is free from symptoms. At a dental school there may often be a waiting period before the restoration is placed due to scheduling issues. In all these instances a good seal in the access cavity would be beneficial for the future of the tooth. The nitrocellulose-butyl acetate gel shows promise as an agent to protect root fillings from the oral flora.

24 "Passive Immunity in Parkinson's Disease"

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Background: Parkinson's Disease (PD) is the second most common neurodegenerative disorder. Inspection of postmortem samples from patients with sporadic and familial PD reveal the presence of intracellular α-synuclein-containing aggregates in neuronal cell bodies. This raises the notion that α-synuclein may play a role in the pathogenesis of the disease. To determine whether the opsonization of α-synuclein by antibodies enhances clearance by microglial cells, the blood–brain barrier (BBB) needs to be interrupted to allow the passage of antibodies. The BBB prevents uptake of ~98% of small molecules and prevents the entry of most drugs from the blood into the brain. Even our own IgGs are known to poorly permeate the BBB. Recent research suggests that focused ultrasound (FUS) briefly dismantles BBB, thus allowing the passage of antibodies into the brain.

Objectives: To determine the kinetic distribution of intraperitoneal (IP)-injected antibodies into the blood.

Materials & Methods: 15 Male Adult Mice B6DF1-strain (n=3). Mouse Measles antibody. Human Anti-Measles Virus IgG ELISA Kit. Anti-mouse IgG HRP conjugate. Inject mice IP with measles IgG1. Two experiments: experiment 1, anesthetize mice with ketamine/ xylazine and draw blood at 1-hour post-injection, then sacrifice at 6-hours post-injection. Experiment 2: sacrifice mice at 0, 3.5, 9 and 12-hours post-injection. Plasma IgG1 level measured with ELISA. Immunofluorescence measured based on a standard curve conversion to nanograms.

Results and Conclusions: To determine the antibody concentration needed by the Tecan plate reader, we injected two mice: one with 1 mg/kg and one with 2 mg/kg. Absorbance from the 1 mg/kg injected mice was sufficient. Next, we measured the pharmacokinetics of the antibody. Consistent with comparable work in the literature, our experiment showed that blood IgG1 levels rapidly increased up to 6 hours, then fell steadily. We sacrificed the mice at their respective times. Made 1:10 dilutions from 10 ug plasma. ELISA measured a fluorescent of 0.214 (absorbance at 450–620 nm) at post-6 hours injection, ≈163 ng; in order to increase the blood concentration by one nanogram, approximately 185 ng Ab needs to be injected.

Discussion: Because the mouse measles antibody and the α synuclein antibodies are both IgG1 antibodies, they share the same pharmacokinetic factors. Therefore, these results allow the proper timing of FUS to enable the maximal transport of α synuclein antibodies into the brain. The next step is to take the brain homogenate of the sacrificed mice and measure whether mouse measles antibody passes through the BBB.

Pre-Doctoral Student Abstracts:

Social and Behavioral Sciences, Education, Geriatric Oral Health, Health Services, and Global Oral Health

25"Retrospective Analysis of Training Convocation Participant Data: Impact on Motivation to Serve the Underserved"

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Introduction: Primary care dentists are best suited to meet the needs of low income, vulnerable, and underserved populations. Current training models do not train students enough to deal with vulnerable populations which has led to workforce gaps, significant oral health disparities, and adverse effects to health outcomes and oral health quality of life. Such disparities can be ameliorated by training programs which bring together like-minded dental practitioners to network and transform into interdependent clusters of people with shared interests, also known as communities of practice (CoP).

Objectives: To assess if participation in a Regional Oral Health Training Convocation can impact perceptions, attitudes, and plans of primary care dentists by nurturing a network of providers in order to build a supportive community. We sought to understand how such a convening can be impactful in serving underserved populations through various routes of advocacy and career opportunities.

Materials & Methods: Data were extracted from pre- and post-event surveys from attendees (faculty, residents, and primary care dentists) at the Regional Oral Health Training Convocation hosted by the Columbia University Medical Center College of Dental Medicine (CDM). This program occurred annually for twelve years and data were extracted from 2013-2019. The surveys addressed attitudes and behaviors towards treating patients in underserved populations. Specifically, we measured career intentions before and after participating in the convocation, and if this event had an impact on intention to treat underserved populations. We performed sign rank tests and t-tests to analyze pre- and post-survey differences.

Results and Conclusions: Through the years analyzed (2013-2019), females made up approximately 70% of the audience, about 17% come from a rural background, and about 16% come from a disadvantaged background. From years 2016-2019, over 80% of the participants were White or Asian, and less than 20% were African American or more than one race. From years 2014-2019, about 12% of participants were Hispanic. Analyses of the post evaluation survey every year revealed that over 90% of participants graded the communication, presentation, Q&A commitments of the event either "excellent" or "good". Analyses have shown no significant change pre-to-post in the anticipated likelihood for participants to be involved in community health and health policy career settings.
These findings indicate that the training programs are well received and should be offered more frequently to further engage participants in dental public health careers. Programs nurturing public health perspectives can help alter career trajectories, and while we did not produce evidence that this convocation serves as an agent motivating primary care dentists to serve vulnerable populations, it still created a nurturing network of primary care dentists needed to build a community serving vulnerable populations and create change in the healthcare system.

Discussion: Analyses did not show significant changes in pre-post event surveys in terms of career intentions. The reason may be that one training event is not sufficient to alter someone's ideas about where they plan to work. Future analyses will be conducted to include longitudinal data for participants who attended more than one event. We recommend that future programs target primary care dentists who express some interest to work with underserved populations, and further nurture their career trajectories to become thought leaders within their CoP.

26"Assessing the Relationship between Parent Oral Health Related Knowledge and Parent's Behaviors and Beliefs about their Children's Oral Health"

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Background: The rates of decayed, missing and filled teeth in children have decreased over the past few decades, however the rate of decline has plateaued over the past ten years and the prevalence of dental caries remains particularly high in certain subsets of the population. The management of dental decay in younger age groups falls heavily on the role of parents/guardians and their oral health related knowledge and practices. Parents are responsible for their child's oral health through their knowledge and behavior regarding eating patterns and dietary practices, frequency and technique of toothbrushing, as well as regular dental check ups. If not treated, the effects of severe tooth decay in children can negatively affect a child's growth, body weight, cognitive development and overall quality of life.

Objectives: The aims of this study are to investigate the relationship between parent's oral health related knowledge and the dental beliefs and behaviors practiced at home with their children.

Materials and Methods: A twenty-five question questionnaire was developed and distributed to parents in the waiting room of the Haven Pediatric Dental Clinic. The questionnaire includes questions regarding parent's demographic information, parent's oral health knowledge and questions assessing parent's knowledge of their children's oral health. The number of expected responses is twenty five individuals, making this a preliminary pilot study assessing potential correlations that exist between these variables.

Results and Conclusions: The preliminary findings of our study revealed areas of oral health knowledge that parents were able to answer correctly compared to areas that parents were less knowledgeable about. Some of the questions that stood out as a deficit in oral health knowledge were the understanding of fluoride and its benefits, as well as the length of time that children should brush their teeth for. Another question that was frequently answered incorrectly was the fact that oral health is related to other diseases of the body. The questions in the survey that had a high correct response rate were the frequency with which children should visit the dentist, the importance of not putting a baby or child to sleep with a bottle of juice or milk, and the negative effects of sugary food and drinks on children's teeth.

Discussion: The findings of this study can help pediatric dentists provide personalized dental care to their patients and to the parents of their patients. In addition, these potential relationships can help pediatric dentists better understand the relationship between parent's oral health knowledge and their children's oral health, thus allowing for improvement of oral health information delivery methods.

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27"Developing a Valid Measure of Knowledge, Attitudes and Practices Regarding 27

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Background: The oral health of children in Armenia is compromised due to increased caries risk. It is reported that by age 12, over 86% of Armenian children experience dental caries, compared to 50% in the US. However, the prevalence of caries has not been accurately measured in rural regions of Armenia. Parental role in maintaining proper oral hygiene for children is integral in establishing good practices at a young age and continuing through adulthood. Thus, improvement in children's oral health depends greatly on caregivers' knowledge, attitudes and practices.

Objectives: A pilot study in Berd, Armenia, aims to develop a valid and reliable questionnaire to measure Knowledge, Attitudes and Practices (KAP) of caregivers of children regarding prevention of dental caries.

Materials and Methods: A sample frame of all children aged 2-6 years living in Berd was created by the local hospital. Implementing a cross-sectional survey design, data was collected from 40 randomly selected participants via face-to-face interviews. Among 48 items asked in the questionnaire, knowledge domain included 16 items, attitude domain included 15 items and practices domain included 17 items. After data collection was completed, a Cronbach's alpha was calculated to assess correlations of internal consistency among the 48 questionnaire items.

Results and Conclusions: Cronbach's alpha was calculated for internal consistency in each domain. The coefficient alpha for the knowledge section is 0.11. However, after removing some items, the measure increases to 0.50. The coefficient alpha for the attitude domain is 0.45 and does not change with removal of any items. The coefficient alpha for the practice domain is 0.328. However, with the removal of some items this measure increases to 0.72.

Discussion: The pilot study and analysis indicate the need to revise item constructs and wording of questions in the domains of knowledge and practices prior to implementing the survey nationwide.

28 "WHO Reclassification of Diagnostic System for Oral Dysplasia"

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Background: It is a well-recognized fact that the grading system regarding oral epithelial dysplasia suffers from high degrees of subjectivity, leading to high levels of inter-observer variability. In 2017, the World Health Organization (WHO) proposed a transition from the traditionally used 3-tier (mild, moderate, & severe dysplasia) system to a standardized 2-tier (low grade, high grade) system for assessing oral epithelial dysplasia. The standardization was implemented as a means of decreasing disagreement among oral pathologists, in hopes of increasing accuracy and efficiency in diagnosing oral dysplasia. The proposed system has yet to be adopted by the oral pathology community, as it still requires validation. Though, various review articles have demonstrated that the same dysplasia case, when reviewed by different oral pathologists, is often diagnosed with different degrees of dysplasia. In fact, the *same* pathologist has been shown to assign a different dysplasia grade to the same tissue when the tissue is re-evaluated after a period of time has elapsed. If one diagnosis calls for treatment, while a less severe diagnosis calls for observation, this disagreement can affect treatment, ultimately affecting the overall health of that patient. If moving toward a 2-tier system will increase accuracy and agreement amongst oral pathologists, then there is the opportunity for decreasing the ambiguity surrounding diagnosis of oral dysplasia.

Objectives: This goal of this study was to compare the intra- and inter-observer variability amongst CDM oral pathologists regarding the diagnosis of oral dysplasia cases. Both the current three-tiered system and the proposed two-tier system were utilized in grading of the oral dysplasia cases in patients treated at Columbia University Medical Center.

Materials & Methods: Histologic slides of 100 oral dysplasia cases were pulled from Columbia University's Department of Pathology archives. The cases were chosen to represent all categories of the 3-tiered system: mild, moderate, and severe; these cases were de-identified, and evaluated using both the current, and new proposed systems. To assess intra-observer reliability, the 100 de-identified cases were given to a CDM oral pathologist to classify the cases according to the three-tier system. A week later, the same 100 cases were re-issued to the same oral pathologist the cases were classified according to the two-tier system. This process was replicated again during the third and fourth week. To assess inter-observer reliability, 2 CDM oral pathologists were initially asked to classify the cases according to the 3-tier system. After two weeks the same 100 cases were re-issued, and the same 2 oral pathologists were asked to classify these cases according to the 2-tier system. Percent agreement was reported, and κ-Statistics were used to determine the degree of intra-observer and inter-observer agreement. A Cohen κ-Statistic was used to calculate both the intra- & inter-observer variability.

Results and Conclusions:

Intra-observer variability: Upon utilizing the three-tiered system, a κ-Statistic of 0.49348, indicating moderate agreement [0.41 – 0.60.] When the cases were classified according to the two-tiered system, agreement increased from 0.49348 to 0.63928, increasing the degree of agreement from moderate to substantial.

Inter-observer variability: When the level of agreement between the two oral pathologists using the three-tiered system was a *fair* agreement [0.21 – 0.40], yielding a κ-Statistic of 0.28251. When the same two oral pathologists were compared using the two-tiered system, their level of agreement nearly doubled, with a κ-Statistic of 0.54, indicating moderate agreement.

Discussion: The data suggests that the proposed two-tiered system increases inter- & intra-observer agreement. Our findings illustrate a much more drastic increase in inter-observer agreement verses intra-observer agreement. Continuing this research will further illustrate if the proposed two-tiered system truly decreases variability and increases agreement amongst oral pathologists surrounding oral dysplasia grading. Supplementary research and data would require a larger sample size, in addition to a greater number of oral pathologists.

29"Barriers to Child Nutrition & Oral Health Among Families at an Upper Manhattan Head Start Program: a Community Needs Assessment"

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Introduction: Previous studies have shown that pediatric populations of upper Manhattan have higher caries rates compared to New York City residents as a whole. Diet modifications and proper oral hygiene are crucial in preventing dental caries. Although nutrition is a determined cause of dental caries and there is ample research regarding oral health disparities, there is a lack of research regarding parents' understanding and beliefs towards the impact of nutrition on their child's oral health.

Objectives: To assess the knowledge, attitudes, beliefs, and practices of parents/caregivers of children attending the Fort George Community Enrichment Center in Manhattan with regard to oral health and nutrition. Findings will inform the development of an educational workshop for parents at the Center.

Materials & Methods: A novel, paper survey was designed and administered to a convenience sample of parents at an annual health fair at the Center. The survey included an assessment of intake of food groups per week. The data were coded and tabulated for analysis.

Results and Conclusions: Thirty-three parents participated in the survey. While 82% of participants reported that their child has seen a dentist regularly, participants who believe that their child has caries (18%) all rated their child's oral health as "good." Other salient findings include that 85% do not perceive a financial barrier to providing a healthy diet, 27% indicated that their child never drinks (fluoridated) tap water, and 6% could not read the survey in their native language and required assistance. Further analysis will examine the relationships between food group intake frequencies and oral health beliefs/practices.

Discussion: Lack of oral health knowledge in this population may be due to language/literacy barriers to obtaining health information. Therefore, the educational workshop will include basic facts about oral health, and it will be fully bilingual with all information spoken aloud. Designing a survey instrument that could relate nutritional frequency data to oral health beliefs/practices proved to be theoretically and practically challenging. Future research should address local fluoridated water intake, language/literacy barriers in oral health care, and the validation of oral-health-related nutritional frequency instruments.

30"Online Training Program Aims to Bridge the Gap Between Dentistry and The Opioid Epidemic"

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Background: According to the National Institute on drug abuse at NIH, more than 130 people in the United States die from an opioid overdose daily. Dental practitioners are unique in that they deal on average more frequently with acute pain than most medical providers (the other being ER physicians). In the early stages of the opioid crisis dentists were among the largest prescribers of opioids, and accounted for 15.5 percent of all immediate release opioid prescriptions, particularly in addressing acute pain and dental extractions. A dentist has the advantage of not only identifying changes in a patient's oral health, but also their physical, and mental well-being. Currently, there is no mandated curriculum during dental training for addressing the at-risk patient population. This is a major educational opportunity considering dentists report lack of training for identifying, referring, and managing patients with addictions despite encountering these patients on a regular basis. Furthermore, recent studies suggest that intervention at the level of the prescriber is essential at mitigating the prescription opioid misuse epidemic.

Objectives: Project OHCOE (Oral Health Care in the Opioid Epidemic) is an online training initiative by Columbia College of Dental Medicine (CDM) developed to train dental providers to recognize at-risk populations of opioid misuse. It focuses on three domains: 1) providing tools for dental practitioners to identify at-risk populations; 2) establishing community partnerships and facilitating the referral process for appropriate care; and 3) educating practitioners on alternative treatment methods and emphasizing their role in reducing opioid patients' exposure.

Materials & Methods: CDM collaborated with the Columbia Center for Teaching and Learning (CTL) to develop an educational online training tool, which includes clinical perspectives shared by medical professionals, modules, and pre-and post-assessment surveys. This study analyzes responses and experiences about the module, as well as an improved sense of self-efficacy and knowledge in the treatment of at-risk populations. Additional analysis will evaluate the self-assessment of primary care dental residents.

Results and Conclusions: A pilot trainee reported increased awareness of the opioid epidemic, understanding of risk assessment and health history in practice, and improved self-efficacy to refer and manage appropriate treatment of opioid misuse upon taking the training module. A two-point scale increase was recorded in each domain. An IRB approved study was disseminated in February 2020 to attendees of the 2018 and 2019 CDM convocation which included dental program directors, residents, and practitioners. Data is still being collected and analyzed of the study of Project OHCOE and its goals and objectives.

Discussion: Project OHCOE addresses the educational gaps experienced in dental schools and residency training programs regarding the role of dentistry in addressing, treating and managing the opioid epidemic. Project OHCOE will be a necessary tool to introduce dentistry into the conversation of the opioid epidemic and reduce the incidence and prevalence of opioid overdoses.

31 "Assessing Student Provider – Patient Communication: An Inter-Professional Approach"

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Introduction: Effective provider-patient communication is crucial for meaningful person--centered medical and dental care. Taking an inter-professional perspective, a team of dental and social work students identified areas of communication accord/discord in patients' and students' perceptions of an oral healthcare visit, in order to identify any communication barriers.

Objective: To assess the level of agreement and/or disagreement between patients' and student providers' matched ratings of behavioral and content delivery during a dental visit.

Materials & Methods: An observational cross-sectional study was conducted in a dental school clinic using an instrument combining two validated survey instruments: the Patient (PCAI) and the Student (SCAI) Communication Assessment Instruments. Recruitment of study participants was systematic and matched (patient/provider dyads). Surveys were administered to patients and student providers separately, following an appointment at the undergraduate dental clinic (rr = 98%). Surveys included 4 point Likert item-specific [1(negative) to 4 (positive)] matched scales measuring patient-student assessment of the behavioral characteristics and content of the visit.

Results & Conclusions: Ninety-nine dyads of third- and fourth-year dental students and their respective patient participated, following a dental appointment. The dyads included 52 third and 47 fourth year students who communicated directly (76) or through translators (23) with their patients. Factor analysis identified 5 student communication topics, while 4 patient topics were identified. Topic areas included caring and respect, sharing information, interaction with team members, providing comfort, professional relationship building.

Overall item means for both patient (range 3.67-3.95) and student (range 3.23-3.77) scores were quite high, although patients' scores were consistently higher. Student providers perceived themselves as less confident, less organized and less enthusiastic than perceived by their patients. Both patients and student providers assessed the item, patient involvement in decision-making, least favorably, receiving the lowest mean score (3.23, 3.67), respectively.

Discussion: Involving patients as participants in the feedback process provides a holistic perspective in the evaluation of dental student care giving. A dyadic, matched-pair questionnaire can be helpful in portraying the nature of dental student-patient communication, via analysis of the extent of agreement in matched ratings of communicative content and interaction, during dental school visits.

32"Patient Experiences in Dental School Clinics: A Comparative Analysis of Online Reviews"

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Background: Online review sites have become popular platforms for health care consumers to rate their experiences with health care systems. The literature indicates that these reviews have an effect on patient care (Agarwal et al., 2019; Tran and Lee, 2017). An analysis of online reviews can help dental school clinics learn from patient feedback that is not accessible through formal patient surveys.

Objectives: To (1) analyze online patient-generated reviews posted at dental school review sites, (2) compare emerging themes from patient-generated reviews with domains included in formal patient satisfaction surveys, and (3) assess any associations between online ratings of dental school clinics and dental school characteristics.

Materials & Methods: A cross-sectional analysis of patient-generated online reviews related to patient experience at dental school clinics was performed between July and September 2019. The Google and Yelp review sites of 65 dental schools were identified by a calibrated investigator. School ranking was assessed against school characteristics that reflected school mission, funding, location, and other factors using quantitative analysis. In addition, a thematic analysis of randomly selected patient-generated reviews (every 10th review) was conducted using NVivo software; themes emerging from this analysis were further compared with domains included in formal patient surveys, including the Dental Satisfaction Questionnaire (Davies and Ware, 1982).

Results and Conclusions: Sixty-five of 66 dental schools in the United States had reviews available on Google, Yelp, or both. For Google reviews, the mean (SD) online rating for 63 dental school clinics was 3.6 (0.6) of 5.0 possible stars (range, 2.0-5.0 stars); for Yelp reviews, the mean (SD) rating for 55 dental school clinics was 3.1 (0.9) of 5.0 possible stars (range, 1.0-5.0 stars). A higher Google rating was associated with a school location in a health professional shortage area and a mission statement that did not mention oral health. A higher Yelp rating was associated with dental schools founded after 1934. Most patient comments were negative. The thematic analysis revealed 13 themes, which were then categorized into 3 primary domains: faculty and student professionalism, clinical proficiency of students, and practice management. Although most reviews related to these themes were negative, comments regarding "appearance" and "attitude and demeanor" in the professionalism domain were generally positive. A comparative analysis of online reviews and formal patient surveys recommended for use in dental schools (Lafont et al., 1999; Davies and Ware, 1982) indicated that several areas, such as staff communication skills, scheduling appointments, and student efficiency, were not sufficiently addressed by those surveys.

Discussion: School age, location, and mission statement were associated with dental school social media rankings. Online patient reviews posted in dental school review sites were mostly negative, and reflect a wide range of categories that are not fully reflected in patient satisfaction surveys recommended for use in dental schools.

33"Barriers to ECC Disease Management in NYC Pediatric Dentistry Residency Programs"

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Introduction: Untreated caries remains the most common chronic disease of US preschoolers, twice as prevalent as early childhood asthma. Significant Early Childhood Caries (ECC) experience is consequential in pain, dysfunction, and compromised appearance with associated social and behavioral consequences. ECC treatment has traditionally been comprised of counseling (to limit cariogenic diets and feeding practices plus increase use of fluoridated toothpaste) combined with surgical repair of extant lesions, often with the child under general anesthesia in the operating room (OR). Because dental repair does not inhibit caries progression and counseling has limited effectiveness on salutary oral health behaviors, conventionally treated children experience high rates of disease relapse. The American Academy of Pediatric Dentistry's (AAPD) guideline for children at high risk of ECC calls for combining dental repair with topical fluoride application every three months, salivary mutans streptococci level monitoring, sealant placement, monitoring of white-spot lesions, and counseling parents on diet and brushing with a smear of fluoridated toothpaste. Pharmaco-behavioral approaches to ECC management and suppression, like Columbia's MySmileBuddy Program (MSB), utilize motivational interviewing to facilitate adoption of consistent and sustained home-based, salutary oral health behaviors. This study assesses current ECC management among New York City (NYC)-area pediatric dentistry residency programs. **Objectives**: To explore how ECC is managed in NYC-area pediatric dentistry residency programs and explore barriers to adopting health behavioral management.

Materials and Methods: This study involves a secondary analysis of data previously collected for the MSB program; a home-based health behavioral intervention delivered by technology-assisted community health workers. Key informant interviews with 7 NYC-area Program Directors and 10 Chief Residents (CRs) were conducted between 2017 and 2018 regarding non-surgical ECC behavioral management. The hour-long interviews were digitally recorded and transcribed for qualitative thematic analysis.

Results and Conclusion: All respondents prioritized dental repair in the OR and endorsed use of topical Silver Diamine Fluoride for caries arrest as a holding procedure while awaiting the OR. Four CRs, but no Directors, stated that they "aggressively" treatment plan white spot lesions with composite restorations or stainless-steel crowns in order to limit future caries progression. Five CRs and two Directors reported increasing diet and hygiene counseling while patients await the OR. Ten informants reported barriers to behavior counseling, including lack of time during a dental appointment. Four CRs additionally stated that affected patients only present for treatment of pain and infection ("emergencies") and not prevention, limiting the opportunity to address behavioral change. Other reasons noted for lack of health behavioral counseling included lack of reimbursement and lack of substantive training in motivational interviewing. Multiple respondents noted the potential value of partnering with other social, nutrition, and health professionals to assist parents in adopting caries-suppressing behaviors.

Discussion: Findings suggest that current training programs do not prioritize behavioral management for ECC and are not delivering care consistent with AAPD guidelines.

34"Pain Medication Prescription and Use after Oral and Maxillofacial Surgery Procedures"

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Background: Pain management is a critical part of patient care. Insufficient pain control can lead to poor outcomes, but there is heightened attention surrounding the alarming rise in pain medication prescription and abuse. This highlights a challenge facing healthcare providers: the duty to treat pain juxtaposed with the responsibility to judiciously prescribe analgesics. In this study we evaluated pre-operative risk factors and post-operative pain management. This information may inform perioperative counseling, which can improve post-operative pain control and decrease the risk of analgesic abuse.

Objectives: The goal of this two-part study was to identify risk factors that could help predict (1) analgesic use and (2) patient pain tolerance after a variety of OMS procedures through peri-operative surveys.

Materials & Methods: Patients were recruited in this prospective cohort study to assess pain and analgesic use after OMS procedures. Subjects were given pre-operative surveys to evaluate risk factors that might influence post-operative pain and analgesic use. Subjects rated their maximum daily pain using a visual analog scale and recorded the quantity and frequency of medication used for seven days post-operatively. Demographic information, including age, gender, and prescribed medication, was also evaluated. Two sample independent t-tests were used to compare predictors and outcomes.

Results and Conclusions: A statistically significant relationship between gender and post-operative acetaminophen use was observed during all seven postoperative days. The average use of 650mg tablets decreased from 2.50 to 1.28 for females, and from 4.16 to 2.74 for males. A statistically significant correlation was also seen between age and acetaminophen use during post-operative days 2-6. Average use of 650mg tablets decreased from 3.08 to 2.32 for subjects under 30 years, and from 1.33 to 1.30 for subjects over 30 years.

Discussion: Few studies have examined pain after OMS surgery. In this cohort, we find a significantly higher use of post-operative acetaminophen in men as compared to women in the absence of a difference between post-operative pain between the two genders. Additionally, post-operative use of acetaminophen was significantly higher in younger subjects. The age of 30 years was chosen to discriminate between younger and older subjects, however, results may differ if another value was selected. Literature regarding analgesic prescription, use, and pain tolerance between genders and age is conflicting. Future studies with a larger sample size and evaluation of additional risk factors such as prior surgical history, opiate use, ASA status is warranted.

35"The Impact of Language Barriers on Patient-Provider Communication From The Perspective of Dental Students"

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Background: As more dental institutions aim to teach and deliver patient-centered care, the need to optimize patient-provider communication has also grown. The number of people who are considered to have Limited English Proficiency (LEP) has increased, and research has underscored the vulnerability of this particular population. Little is known about communication competence of dental students with LEP and non LEP patients.

Objectives: The purpose of this study was to examine dental student self-reported communication competence when engaging with patients with and without LEP. We hypothesized that language barriers between dental students and Spanish-speaking LEP patients would undermine communication.

Materials & Methods: A 58-item web-based Qualtrics survey regarding their most recent clinic experience working with English-speaking (non LEP) and Spanish-speaking LEP patients was distributed to third and fourth-year students at Columbia University College of Dental Medicine. Items included demographics, language proficiency, suggestions to improve clinical experience and 45 7-point Likert scale questions from the Medical Communication Competence Scale (MCCS). The MCCS contains 4 communication subscales: information-giving, information-verifying, information-seeking, and socioemotional communication. Data analyses included descriptive statistics, differences in communication competence with LEP versus non LEP patients (paired t-test), and group differences in communication competence with LEP patients stratified by student Spanish language competency (students t test).

Results and Conclusions: 79 students (43.6% 4th year; 60.3% female; 39.2% Spanish language fluency) completed the survey. Translation assistance was used for 69% of student encounters with Spanish-speaking LEP patients. Communication scores with non LEP patients were higher compared to Spanish-speaking LEP patients across all subscales (all p values <0.001). Information-verifying (p=0.02) and socioemotional communication (p=0.02) scores with Spanish-speaking LEP patients were significantly higher for students who reported at least some Spanish fluency compared to those with no Spanish fluency. Students recommended the need for a Spanish course as part of the school curriculum (51%) and on-site translators in the clinic to improve the clinical experience (38%).

Discussion: Dental students in this sample demonstrated less communication competence with Spanish-speaking LEP patients compared to their interactions with non-LEP patients. Those with Spanish fluency scored significantly higher in information verifying and socioemotional communication with Spanish-speaking LEP patients compared to students lacking Spanish fluency, which suggests that these domains require higher level language skills. To decrease language barriers between dental students and their patients, survey participants recommended inclusion of a course in Spanish and availability of on-site translators in the clinic.

36"Body donation as a grateful gift for a long and active life with a Björk-Shiley valve"

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Background: The the Björk-Shiley tilting flat discs mechanical valve was introduced to the market in 1971. The goal was to reduce the existing ball-and-cage design's fatal consequences including calcification and rupture of the leaflets. Soon after, the flat disc valve design went through a series of modifications in effort to reduce turbulent flow, large profile and the need for permanent anticoagulant therapy. Initially, the Björk-Shiley flat disk model material changed from Delrin to pyrolytic carbon. Later, the disk design changed from flat form to a convexo-concave form, and eventually they introduced a new version of the valve's disk opening angle from 60 to 70 degrees. Despite the new Björk-Shiley Convexo-Concave (BSCC) valve design's aims to address the issues of the existing flat disk model, it introduced unique challenges including fracture of the outlet strut and calcification which led to embolism in patients resulting in a high mortality rate shortly after the implantations. As a result, further modifications were made on the opening angle, welding, and well-to-disk length. Though innovative, the later valve design was withdrawn from the market and explanted from numerous patients due to high chance of developing fatal side effects
.
Objectives: We hypothesized that the patient's prosthetic heart valve was in good conditions with no signs of significant issues that would lead to prosthetic heart valve failure.

Materials and Methods: 87 years old body donor's heart with a 34-year Björk-Shiley pyrolytic carbon tilting flat disk prosthetic aortic valve was dissected out of the patient's body. The heart was measured and analyzed before further dissection was conducted. The heart was dissected at multiple sites to obtain measurements such as ventricular wall size and ascending aorta diameter. The superior chambers were dissected mid-way exposing the prosthetic valve in-situ. Ultimately, the prosthetic heart valve was dissected out of the patient's heart for further review.

Results and Conclusions: The valve analysis revealed no signs of fracture, malignant tissue fibrosis or thrombus formation suggesting the valve's overall good functionality.

Discussion: Almost 300,000 Björk-Shiley flat disk aortic and mitral valve implantations were performed before the design was discontinued. The survival rate for the flat disk design was 85 percent after 5 years, 70 percent after 10 years, and 55 percent after 15 years. The major complication reported with this design were thromboembolism and turbulent flow. The change in material from Delrin to pyrolytic carbon did not improve the thromboembolism issue. Björk-Shiley Convexo-Concave (BSCC) valve design was then introduced with an effort to reduce the rate of thromboembolism. Soon after, this new design was removed from the market due to numerous reported cases of valve fracture, which led to high mortality rate. Eventually, the Monostrut valve design was created to alleviate the fracture issue while lowering the number of thromboembolism incidence. This Monostrut valve replaced both flat-disk and convexo-concave disks, remaining in the market for the next several decades. Despite the reported high mortality rate of the earlier designs, some patients survived for longer than expected highlighting the high functionality of the earlier Björk-Shiley prosthetic heart valve design.

37 "Attitudes, Beliefs and Knowledge of Nutrition and Oral Health among Parents of Children in a Head Start Program"

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Introduction: Dental caries is a multifactorial disease and when left untreated, leads to pain, abscesses, missed school, loss of sleep and difficulty eating and speaking. Minority children and those in low-income families have a higher incidence of early childhood caries. Residents in Northern Manhattan have lower income and adolescents with poorer oral health than the averages for all residents in New York City. Diet modifications and oral hygiene practices are crucial in preventing dental caries.

Objective: This project aims to assess changes in knowledge and attitudes regarding nutrition and oral health following an educational intervention for caregivers of children at a Head Start program. An initial needs assessment informed the intervention.

Methods: An intervention was developed following the analysis of a caregiver needs assessment survey at a Head Start program. Fourteen parents and grandparents of 3- to 5-year-old children at the school participated. The intervention addressed nutritional impacts on oral health and oral hygiene practices for children. Surveys were administered before and after the intervention. An open-ended comment section was included in the post-intervention survey to allow participants to provide qualitative feedback. Survey responses were scored and analyzed.

Results and Conclusion: Post-survey responses showed increased knowledge regarding oral hygiene practices and an improved understanding of how certain foods impact oral health. Parents displayed pre-intervention knowledge of certain nutrition topics, such as the negative impact of sugar on oral health, indicating success in previous oral health workshops provided to this community. 86% of participants reported the intervention was "extremely" or "very" likely to change how they care for their child's oral health. Additional statistical tests will be conducted for further comparative analysis. These results suggest improved knowledge regarding oral health and nutrition following an educational session. The responses with the greatest improvement addressed oral hygiene practices, whereas nutrition topics revealed a need for further education.

Discussion: The results of the post-survey show that in-person presentations on oral health education are successful in increasing knowledge and changing attitudes about oral hygiene practices and the impact of nutrition on oral health. Future research should involve expanded educational interventions regarding the impact of nutrition on oral health and caregivers' perception of educational sessions.

38 "Barriers in Oral Health in the Older Population"

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Objectives: The aim of this study was to identify various barriers in providing good oral care to the older population, which will help in the initiation of necessary steps in addressing these concerns. The long term objective includes the improvement in oral care and overall quality of life in the older population.

Introduction: The burden of oral health diseases amongst the elderly poses a strong challenge for the patient and those caring for them. Greater attention is needed towards the promotion of oral health care of the seniors. According to the US Census, by 2060, the number of older adults in the US that are age 65 years and above is expected to reach around 98 million, which amounts to roughly 24% of the overall population.

Materials and Methods: A cross-sectional study design was used with a sample size of 50. Study participants were recruited from the patients aged 60 years and above, all sexes and ethnicities visiting the 'Triage' clinic at Columbia University College of Dental Medicine. The target population was asked to answer a survey questionnaire regarding their perceived barriers to oral care. Normality of quantitative data (assessing importance of Barriers) was checked by measures of Kolmogorov Smirnov Tests of Normality. The comparisons for dichotomously categorized groups were made with the Mann-Whitney test. P value of 0.1 was considered statistically significant in this pilot study.

Results and Conclusions: The results showed that the major barriers were Insurance/Cost of Dental Treatment, Anxiety/Fear and Transportation. The objective of identifying various barriers to oral health was accomplished as a preliminary step, paving the way to find ways in which to overcome these barriers. More research is required to learn why people with dental insurance find the cost of dental treatment a major barrier. Also, barriers to oral health need to be studied further, on a larger scale, in order to overcome them.

Discussions: This was a pilot study with a small sample size. The next goal will be to conduct a study with a larger sample size to better assess statistically significant results. The primary source of data collection is the strength of the study. The paper survey used as a screening tool had high reliability and validity. Since the data were skewed, parametric tests could not be used, which are more robust in statistical analysis.

39"Evaluation of a Dental Materials Manual for Faculty Calibration"

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Background: Dental treatment planning and diagnoses can vary broadly based on the practitioner's educational history, training, and training experience. (Bader & Shugars, 1995) Dental restorative materials available to the clinician can moreover affect the eventual treatment modalities chosen. A standardized reference of restorative materials for CDM students and faculty has been developed. This study aims to evaluate changes in faculty knowledge of available dental materials and their proper applications/uses following faculty calibration through use of the clinical materials manual. Citations: Bader, J.D., & Shugars, D.A. (1995). Variations in Dentists' Clinical Decisions. *Journal of Public Health Dentistry*. 55(3), June 1995. P.181-188.

Objectives: To evaluate the effects of delivering a standardized dental materials manual to CDM clinical floor faculty on knowledge of restorative dental materials through statistical analysis of pre- and post-test performance.

Materials & Methods: The study team developed a comprehensive restorative dental materials manual and pre/post test assessment consisting of 10 multiple-choice questions. Prior to distribution of the clinical material manual, the pre-test was administered to clinical floor faculty (n=13). Following receipt of the training manual, faculty were instructed to study and reference the manual. Faculty members took a post-test following a review period of several weeks. Data from these assessments were analyzed to observe statistically significant differences in performance.

Results and Conclusions: Among the members of the faculty who took the pre- and post-test (n=13), the average score improved from 45% to 85%, a 40% gross score improvement. The difference in score was statistically significant when analyzed using paired student t-test ($P < 0.0005$).

Discussion: Our findings suggest that the delivery and use of a clinical materials manual may result in improvements in faculty knowledge related to the dental materials used on the teaching floor, as evaluated through a pre- and post- test assessment. Better consensus of faculty knowledge was suggested through an improvement in scores. Further study can include evaluation on student knowledge of restorative dental materials before and effort utilizing the manual.

40"Assessment of a Novel Electroencephalography (EEG) Headband for Neurofeedback In Pediatric Dentistry: A Pilot Study"

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Background: Severe dental anxiety and inability to cope with treatment remains a challenge in Dentistry especially when it comes to children. While pharmacological behavior guidance and physical monitoring continue to be the mainstay for dental anxiety management, there are no tools that offer the clinician a chairside, real-time measure of a patient's state of mind. The following study assesses a novel, brain sensing headband (Muse 2™) in a dental setting for the first time. Muse is an EEG device with a companion APP that uses advanced signal processing to interpret mental activity while providing audio-guided neurofeedback cues that help focus on breath and calming the mind. Monitoring EEG brain activity, as we monitor conventional vital signs via wearable devices, may offer a new understanding of anxiety management as it relates to dentistry.

Objective: To assess and compare Muse 2 EEG monitoring data and neurofeedback effects with conventional dental anxiety measures in a dental clinic setting.

Materials & Methods: A cohort of 4 children between ages 7-13 were recruited at the Columbia University CDM undergraduate pediatric dental clinic for enrollment in the Muse case group and compared to 4 control subjects randomly selected from a related study. Patients in the control group wore conventional sunglasses (CS), while patients in the Muse group wore the Muse 2 headband (M2). Those in the Muse cohort underwent a 1-5 minute neurofeedback session with EEG recording prior to and for the duration of the dental procedure. Self-reported anxiety levels were measured at three separate periods: before, during and after the procedure using Venham's picture test. The dental providers also rated patient anxiety using Venham's rating of clinical anxiety. Additionally, clinical events were mapped to EEG brain activity. The overall anxiety score for each cohort was averaged for the three separate time periods. Patient and provider scores were then adjusted to a 0 (least anxious) to 8 (most anxious) rating and the means of both ratings for both cohorts (for each time period) were calculated. A paired two-tailed t-test was run to compare the average 'during-treatment' anxiety ratings between the cohorts.

Results and Conclusions: A 1.67 anxiety score for the CS cohort and a 0.32 anxiety score for the M2 cohort was reported. The results revealed a statistically significant difference with a t-value of -2.6 with a $p < 0.05$. Finally, the EEG to clinical mapping revealed a direct correlation to intraoral clinical events in the form of upward spikes in brain activity. Our pilot study demonstrates proof-of-concept and feasibility using EEG-assisted neurofeedback devices in the management of dental anxiety and warrants further investigation.

Discussion: The use of EEG monitoring has been historically absent from clinical dentistry due to complexities in brainwave study, hardware and perceived lack of applications. Advances in technology now offer algorithmic interpretation of EEG measurements and other vital signs in the form of a simple and reliable wearable device such as the Muse 2. Such devices are commercially marketed to the general public interested in mindfulness or meditation practices for $225. This EEG "brain sensing headband" also features PPG (heart rate) pulse oximetry, PPG/gyroscope (breath), and an accelerometer (body movement) providing a multi sensor experience. Easy access to a patient's brain activity/chairside EEG with neurofeedback interventions could open the door to several potential aspects of dental practice and research particularly in the areas of anxiety management, biofeedback therapies, sedation monitoring, sleep and seizure disorders and personalized care for children and adults.

41 "Evaluation of a Full-Day Cultural Competency Workshop for First-Year Dental Students and Residents"

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Background: Cultural competency has become an essential part of training across the health professions. To function successfully in a multicultural work environment, dentists must be capable of managing a diverse patient population. Many dental schools have instituted mandatory cultural competency workshops for their students but the effectiveness of these workshops has not been fully examined.

Objectives: The goal was to evaluate the effectiveness of the full-day cultural competency workshop, "Self, Social, and Global-Awareness: Personal Capacity Building for Professional Education," given to first-year dental students (DDS-I) and residents (PGY-I) at Columbia University College of Dental Medicine (CDM).

Materials & Methods: The incoming CDM classes of 83 DDS-I and 30 PGY-I students attended a mandatory full-day cultural competency workshop. Students' perceptions regarding their cultural competency were assessed using a 10-item survey developed to correspond to the learning objectives of the workshop. The analyses compared the students' awareness, knowledge, and skills in cultural competency before and after the workshop as well as within and between the DDS-I and PGY-I groups. Univariate and bivariate analyses of student responses were conducted using paired and student t tests (significance threshold $\alpha = .05$). Workshop facilitator interviews and formal course evaluations for the students were administered to understand their perception of the workshop.

Results and Conclusions: 97% of DDS-I students and 80% of PGY-I residents responded to the pre- and post-workshop surveys. The mean [SD] scores for DDS-I students were higher on the post-workshop survey than the pre-workshop survey in overall cultural competency (pre: 29.8 [3.5] vs. post: 34.6 [3.8]) and for individual sub scores (awareness - pre: 11.9 [1.8] vs. post: 13.8 [1.6], knowledge - pre: 6.2 [1.0] vs. post 6.9 [1.0], and skills - pre: 11.7 [1.6] vs. post: 13.9 [1.7]). PGY-I residents showed similar improvement in mean scores [SD] for overall and individual cultural competency scores. Score improvement was statistically significant ($P < .01$). No statistical differences were found between the DDS-I students and PGY-I residents. Analysis from four facilitator interviews indicated that DDS-1 students were more insightful, engaged, and familiar with workshop concepts than PGY-I residents. The course evaluation indicated that students thought the workshop was useful and similar workshops should be introduced in the future.

Discussion: The study results suggest that the full-day workshop was effective in eliciting a statistically significant increase in cultural competency in both DDS-I and PGY-I groups. Future studies can conduct a follow-up survey with the groups to evaluate retention of the cultural competency knowledge imparted by the workshop.

Post-Doctoral Student Abstracts

42 "Validation of cell-specific decomposition of gingival tissue transcriptomic signatures in periodontal health and disease"

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Background: Periodontitis is a chronic inflammatory disease that is associated with microbial dysbiosis and characterized by loss of connective tissue attachment and alveolar bone. Identification of transcriptomic signatures in the different cellular subtypes of the gingival tissue has the potential to elucidate key molecular mechanisms underlying the initiation and progression of periodontitis. In the first phase of this project, we applied Population-Specific Expression Analysis (PSEA), a computational method that deconvolutes whole tissue transcriptomes into cell-specific signatures, to predict cell-specific differential gene expression in gingival tissues in states of periodontal health and disease.

Objectives: The current work focused on the validation of the PSEA-predicted transcriptional signatures in gingival epithelial and B cells in healthy and periodontitis-affected gingival tissues using independent, non-computational methodologies.

Materials & Methods: PSEA of gingival tissue samples identified several genes as being differentially expressed in periodontal health and disease in epithelial cells (COL4A2, C16orf58, CYGB, TGFB1, RORA, WDR45, YOD1, SH3GL3, EPN3, DUSP14, OAF), and in B cells (CERS3, CAMSAP1, HMGCR, INPP4A, THEMIS2, FAM46C, GNG7, IL10RA). For validation, pairs of gingival tissue samples, each from a periodontally healthy and a periodontitis-affected site of the same patient, were harvested from 15 patients undergoing periodontal surgery (IRB protocol: AAAR0526). Periodontitis-affected gingival tissue samples showed bleeding on probing (BoP), probing depth (PD) ≥5mm, and clinical attachment loss (CAL) ≥ 3mm; periodontally-healthy control sites showed no BoP, PD ≤3mm, and no CAL. All patients were non-smokers. Patients with diabetes, autoimmune diseases, and those who required antibiotic prophylaxis prior to dental appointments were excluded. Tissue samples were processed to form a single-cell suspension, using a gentleMACS dissociator. Immuno-magnetic separation of epithelial cells and B cells was performed using CD326 (EpCAM) and CD19 magnetic MicroBeads, respectively. RNA extracted and quantified using NanoDrop 1000 device. cDNA synthesis was performed using a High Capacity cDNA Reverse Transcription Kit. A quantitative real-time PCR assay was performed to validate differential expression of selected predicted candidate genes in epithelial cells (TGFB1, RORA) and B cells (CERS3, CAMSAP1).

Results: The mean age of the patients was 53 years (range, 35 to 72 years). On average, study participants had 25 teeth present. Among the harvested gingival tissue samples, mean PD was 2.7 ± 0.6 mm at healthy sites and 5.4 ± 2.1 mm at periodontitis-affected sites; the latter showed a mean CAL of 6.9 ± 2.2 mm. Analyses of paired samples from periodontitis-affected and healthy sites obtained from the same donor showed significantly lower levels of RORA and TGFb in epithelial cells isolated from periodontitis-affected sites, consistent with PSEA predictions (p<0.05; n=8 pairs for RORA, n=7 pairs for TGFb). Likewise, in unmatched analyses that included the total number of samples that were successfully processed irrespective of donor, RORA and TGFb were significantly lower in epithelial cells isolated from periodontitis-affected sites compared to healthy sites (p<0.05, n=22 for RORA, n=18 for TGFb). Validation experiments in B cells are currently ongoing.

Conclusions: The PSEA can be successfully used in the deconvolution of the human gingival transcriptome. It may represent a computational alternative to experimental separation methods and can facilitate a better understanding of the cell-specific molecular changes occurring during the course of periodontitis.

43"Smoking Status and Incidence of Peri-operative Complications of Lateral Window Sinus Lift Augmentation Surgery: A Retrospective Case-Control Study"

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Background: Sinus lift augmentation is routinely used to facilitate implant placement in the atrophic posterior maxilla. However, the procedure requires adequate treatment planning and proper case selection in order to minimize the incidence of peri-operative complications. Several studies have implicated tobacco smoking as a factor associated with an increased risk of adverse outcomes following oral surgical procedures. In addition to the well-established effects of tobacco smoking on the immune response and wound healing, smoking is also known to perturb the respiratory epithelium of the maxillary sinus by paralyzing mucociliary clearance and impairing its secretory capacity. This can, in turn, adversely affect sinus function and healing after surgery.

Objectives: To compare the incidence of peri-operative complications associated with lateral window sinus lift augmentation (LWSLA) in smokers and non-smokers.

Materials & Methods: We conducted a retrospective analysis of electronic health records (EHRs), including pre-surgical cone beam computed tomography (CBCT) imaging, of all patients undergoing LWSLA at the postdoctoral clinics of the Columbia University College of Dental Medicine (CDM) between July 1, 2011 and May 30, 2019. The study procedures were approved by the Institutional Review Board of the Columbia University Medical Center (IRB protocol #AAAS4188). During the stipulated period, a total of 541patients underwent LWSLA. Of those, we included in the analyses all current (N=35) and former smokers (N=13), and matched them by sex and age with randomly selected non-smoker controls at a 1:2 ratio (N=96). Data were extracted from EHRs for concurrent health conditions, peri-operatively used medications, surgeon affiliation, grafting materials used during surgery, number and time of follow-up visits, and incidence and type of reported intra- and post-operative complications. Pre-surgical CBCT imaging was used to examine the presence of sinus pathology and osseous septum within the surgical field, and to measure membrane thickness and residual alveolar bone height. Descriptive statistics of the collected variables were conducted; chi-squared tests compared frequencies; and t-tests compared means of continuous variables in the two groups. Regression models were generated to evaluate the association between smoking status and the incidence of complications.

Results and Conclusions: A total of 177 LWSLA procedures were carried out in the 144 patients included in the study sample (mean age: 60.9 ± 7.5 years; 44.4% female). 22.9% of the study population had bilateral LWSLA, 34.3% of cases and 23.1% of the controls. The mean residual ridge height was 3.7 ±1.6 mm for cases vs. 3.8 ± 1.3 mm for controls (p=0.3277). Pathological findings were detected in 60.7% of CBCT imaging in cases and 60.9% in controls, the most frequently observed one being Schneiderian membrane (SM) thickening (50% in cases and 47.5% in controls, p=0.8260). Among patients with SM thickening, this amounted to 4.2 ± 3.4 mm in cases and 4.5 ± 2.5 mm in controls (p=0.3558). Septum was present within the surgical field in 36.1% of the cases and 30% of controls (p=0.5029). The most commonly observed complication in both groups was SM perforation, occurring in 31.7 % of the cases and 20.2% of the controls (p=0.1348). Likewise, post-operative infection was somewhat more frequent among cases (7.9%) than controls (3.5%) (p=0.2110). In comparison to non-smokers, smokers were found to have higher rate of post-operative swelling (19% vs. 14%, p=0.4221) and more frequent ecchymosis (7.9 vs. 3.5%, p=0.2110). Flap dehiscence occurred in 3.2% of the cases and 3.5% of the controls (p=0.9080). Post-operative pain was more frequent among controls than among cases (10.5% vs. 4.8%, p=0.2072). In sum, our data failed to document a statistically significant effect of smoking status on the incidence of peri-operative complications of LWSLA.

Discussion: These findings should be analyzed with caution due to the retrospective nature of this study. The small sample size has likely impacted our ability to detect statistically significant differences between the groups. In addition, strict case-selection in an educational setting may have limited the number of adverse outcomes in both groups, as reflected by the comparable SM thickness between current/ever smokers and non-smokers. Further studies are necessary to examine the impact of smoking on LWSLA procedures.

44 "Wait-listed Patients and Walk-in Emergencies"
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Background: Dentists treat patients who present special challenges related to their age, behavior, medical status, developmental disabilities, or special needs. Caries, periodontial diseases, and other oral conditions, if left untreated, can lead to pain, infection, and loss of function. These undesirable outcomes can adversely affect learning, communication, nutrition, and other activities necessary for normal growth and development. Further, many medical conditions (e.g., hematologic, oncological, cardiologic) are exacerbated by the presence of oral maladies and disease. To address these challenges and to effectively provide the treatment needs, dentists have developed and employ a range of management techniques, including accessing anesthesia services and the provision of oral health care in a hospital-setting with general anesthesia. However, surgeon competition, postponement and delay of elective cases, and economic factors are challenges experienced by dentists in gaining an opportunity to schedule operating room time resulting in lengthy wait times.

Objectives: To analyze average wait times for the provision of oral health care in a hospital-setting with general anesthesia and emergency dental treatment completed at a community dental clinic among those wait-listed.

Methods: A retrospective chart review of patients, ASA I or II, who had dental treatment in a hospital-setting with general anesthesia between July 2017 to May 2019 was completed. Patients requiring coordination of care with other medical services are expedited and were excluded. Dental records were reviewed to determine wait-list duration and whether these patients presented to the dental clinic as an emergency walk-in. Wait-list start/ end times and number of emergency dental treatments (e.g., therapeutic pulpotomy or extraction) completed during wait were documented. Data were grouped into <2 and ≥2 dental emergencies. Descriptive statistics and the Kruskal-Wallis test were used to compare groups.

Results & Conclusions: Of 417 charts reviewed, 294 patients met the inclusion criteria; 44% were female; mean age was 62 months (27 mos - 129 mos); the average wait-list duration was 228 days (2 days – 1365 days) while the mean number of days before the first emergency was 73 (0 days – 730 days). The majority of patients (n = 222; 75.3%) had no emergency dental treatment while wait-listed. Those who had presented as emergency walk-ins ≥2 times (n = 34; 11.5%) were wait-listed longer than those who had presented none or once (n = 261; 88.5%) (p < .05).

Discussion: Dental patients requiring care under general anesthesia and their care providers need access to these facilities. Evidence has demonstrated dental treatment under general anesthesia in the operating room is a necessity, as well as in important component of comprehensive care, to assure optimal health, especially those considered high-risk. Longer wait times results in the likelihood that those patients will present with emergency and highlights the importance of scheduled periodic follow-ups while wait-listed.

45 "Evaluation of Recovery Time of PO Midazolam"

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Background: Oral midazolam is commonly used for minor surgical procedures for children. It has advantageous properties, including a quick onset of action, a relatively short duration, and therapeutic effects such as anxiolysis and anterograde amnesia. Goals of dental treatment with sedation are to guard and monitor the patient's safety and welfare, control anxiety, minimize psychological trauma, maximize the potential of amnesia, modify behavior and/or movement to allow safe completion of the procedure, and to return the patient to a state where s/he can safely be discharged.

Objective: To evaluate the recovery time of patients with a sedation regimen of PO midazolam.

Methods: This retrospective chart review of patients sedated involved a sample of 256 well-children (47% female); 2- to 5-years-old (average age 3.4 years) 30-50 lbs.; ASA I; normal birth history; maximum Brodsky classification grade 2 who received a minor surgical procedure with minimum sedation (AAPD guidelines) using a regimen of PO midazolam 0.4 mg/kg. Post-op, patients were monitored until all discharge criteria were met. Data collected from patient charts included age, sex, recovery time measured from time of sedation medication administration to time of discharge, and a qualitative determination of the effectiveness of sedation. Patients were monitored and evaluated using a modified Aldrete scale to record ratings for sleep, movement, crying, and overall behavior.

Results & Conclusions: The mean recovery time was 108.25 minutes. Males and females had comparable recovery times of 109.45 minutes and 106.88 minutes, respectively. On average, procedure effectiveness using sedation regimen of PO midazolam was considered "effective."

Discussion: The average time from administration of PO midazolam to time of discharge of sedation patients is 108.25 minutes. Findings can be used to gauge recovery room time, evaluation tools, and discharge readiness.

46 "Oropharyngeal Airway Assessment and Provider Experience"

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Background: Sedation is often administered to relieve pain and acute situational anxiety as well as to modify behavior (e.g., immobility) so as to allow the safe completion of a dental procedure. Airway assessment is crucial in identifying appropriate candidates. Currently, the American Association of Pediatric Dentistry clinical practice guidelines are vague with respect to how to assess the airway.

Objective: This study investigates differences in classification and interpretation of the oropharyngeal airway (using the Brodsky classification of tonsil size) by clinical experience.

Materials & Methods: Participants were recruited to complete an anonymous online survey via electronic mail between October 1 and November 1, 2019 from 23 faculty, first-year (PGY-1) and second-year (PGY-2) residents from the Division of Pediatric Dentistry. The survey link was emailed with a description of key study details to inform participants of the research purpose, measures in place to protect anonymity and confidentiality, and to ensure participants were aware of their right to voluntarily complete the survey or opt out entirely or partially (omit specific questions). By continuing to the survey link and answering questions, the participant acknowledged consent to use anonymous responses for analysis. The 3-item survey evaluated participants' experience level and airway assessment by Brodsky classification (Grades 0-4) of an oropharyngeal airway color photograph from a patient of record. No patient identifiers were revealed. Grades were compared to the 'true' size of the oropharyngeal tonsillar tissue, measured digitally, to compare. Due to the small sample, Fisher's exact test was utilized to evaluate associations between experience level and measurement accuracy.

Results & Conclusions: A total of 14 surveys were completed with a response rate of 82.4%. The correct score based on digital measurement was a Brodsky 2 and was chosen by 78.6% of all participants. Out of PGY-2 and faculty, only 27.7% correctly identified the accurate score. All of the PGY-1 residents (100%) correctly identified the score. Though not statistically significant, there was variability in results in Brodsky measurements between PGY-1, PGY-2 and faculty scores. Level of experience was not significantly associated with accuracy of measurement ($p = 0.54$).

Discussion: Patients with anatomic airway abnormalities or moderate to severe tonsillar hypertrophy present issues that require additional and individual consideration for procedural sedation. Variability may exist in oropharyngeal airway assessment using the Brodsky classification of tonsil size.

47 "Walk-in Emergencies for Dental Caries and Scheduling Behaviors"
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Background: Acute dental pain caused by dental caries or acute dental injuries are the most commonly cited occurrences for walk-in emergencies. Though many studies report emergency dental visits at hospital emergency departments, few report describing such visits at a community dental clinic at a large academic medical center.

Objective: To determine the prevalence of walk-in emergencies for dental caries among children previously presenting to a community dental clinic and to assess the proportion of patients utilizing walk-in appointments alone versus scheduled appointments.

Methods: Data from dental records of patients less than 12 years of age who presented as walk-in emergencies for dental caries between 2012 and 2014 were collected. Descriptive analyses of these data was conducted (including sums, modes, distributions, means, medians, and standard deviations as appropriate for variable types, categorical and continuous) as well as correlation analyses to explore associations between key variables of interest. Frequency distributions analysis, chi-square test and analysis of variance (ANOVA) was used to calculate and compare the prevalence rates of caries-related emergency visits from 2012 through 2014 for the total population and by sex, age, chief complaint, diagnosis, treatment, tooth number, if the patient was a patient of record or if it was the patient's first time as a walk-in emergency, if the patient returns for a scheduled appointment, and pertinent clinical findings.

Results & Conclusions: There were 4,328 charts evaluated, of which 2,136 presented as a walk-in for dental caries. The most frequent primary diagnosis was necrosis (n = 2,136; 42%) and the most frequent clinical finding was an abscess (n = 648; 55%). Scheduled appointments in new or existing patients was significantly associated with reduced number of walk-in emergencies ($P < .001$) and reduced frequency of missed appointments ($P < .001$). Dental caries disease accounts for the majority of walk-in emergencies in this community dental clinic.

Discussion: Efforts are needed to ensure that children presenting as walk-in emergencies for dental caries receive a scheduled appointment for follow-up care, which may reduce the number of caries-related walk-in emergencies in the future.

48"Treatment of Peri-implantitis: Clinical Comparison Between Conventional Mechanical Debridement Versus Er,Cr:YSGG Laser Treatment"

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Background: Peri-implantitis is a plaque-associated pathological condition around dental implants, characterized by inflammation in the peri-implant mucosa and subsequent progressive loss of supporting bone. Currently there is no "gold standard" of treatment for peri-implantitis and laser therapy has shown benefits over other treatment options. While there is a variety of lasers and protocols, all share the ability to irradiate bacterial deposits on implant surfaces and clinically reduce pocket depths and inflammation. One of the proposed benefits of erbium lasers is the utilization of water to prevent thermal side effects. Additionally, systematic reviews on the use of laser therapy and other therapies in both non-surgical and surgical settings show inconclusive evidence that any one technique is superior to others.

Aims: To evaluate the efficacy of using a Er,Cr:YSGG laser as a monotherapy compared to mechanical debridement alone for the non-surgical management of peri-implantitis.

Materials & Methods: This study was a double-blinded randomized clinical trial with 32 patients. Patients were included if they presented with at least 1 implant diagnosed with early to moderate peri-implantitis and no previous periodontal treatment other than routine maintenance in the previous 3 months. Examiners and patients were blinded to treatment allocation. Implants corresponding to test patients, were treated with an Er,Cr:YSGG laser (Biolase), following the "Repair Protocol", while the control group was treated with mechanical debridement and sham laser therapy. At the baseline and 9 month follow-up, standardized periapical x-rays and clinical measurements such as probing depths (PD), clinical attachment level (CAL), bleeding on probing (BOP) and plaque index were taken. All patients were seen post-operatively at 1 week and 3 and 6 months for a visual examination. Oral hygiene instructions were provided at all appointments and patients received supragingival polishing at 3 and 6 months. Our primary outcomes included changes in PD and CAL. For pair-wise comparisons between baseline and 9 months of periodontal outcomes in each group, a non-parametric Wilcoxon rank test was used. For comparing the treatment outcome between control and test group, a Mann-Whitney U test was used. A p-value < 0.05 was considered as statistically significant.

Results: Thirty-two patients with a total of 89 implants were enrolled in this study. Prior to randomization, 2 patients were excluded after failing to either comply or meet eligibility criteria. Thirty subjects were randomized. During the follow-up period, 1 patient dropped out due to medical concerns not related to the study. Twenty-nine patients were scheduled to complete the study in April 2020. As of February 2020, 22 patients completed the 9 month evaluation. At implant level analysis, the mean PD at baseline was similar between laser (4.9mm) and control (4.7mm) (95% CI: 4.4-5.3mm and 4.3-4.9mm, respectively) and the mean CAL was 5.7mm (95% CI: 5.1-6.2mm) (laser) and 5.2mm (95% CI: 4.9-5.5) (control). At 9 months, the mean PD improved to 3.6mm (laser) and 4.0mm (control) (95% CI: 3.2-4.1mm and 3.6-4.3mm, respectively). While the PD improvements were significant within both treatment groups between baseline and 9-month follow-up (p<0.0001), there was no statistical difference at 9 month follow up within groups (p>0.05). Similarly, mean CAL at 9 months improved to 4.5 mm (laser) and 4.3mm (control) (95% CI: 3.9-5.1mm and 4.0-4.6mm, respectively) from the baseline but improvements were not significant within both treatment groups (p>0.05). Bleeding on probing decreased from 71% (95% CI: 55%-87%) to 51% (95% CI: 40%-62%) (p<0.05) at implant sites in the control group. In the laser group, percentage of BoP decreased from 81% (95% CI: 69%-94%) to 45% (95% CI: 23%-67%). There was no significant difference in percentage of sites with BoP between implants in the control and laser groups at 9 month follow up (p>0.05).

Conclusions:
- Non-surgical treatment of peri-implantitis by mechanical debridement or laser result in clinically healthier periodontal parameters
- Statistically significant differences were not observed at 9 months between control and laser groups in different periodontal parameters such as CAL, PD, and BOP

49"FadA Modulation Impedes *Fusobacterium nucleatum* Mediated Periodontal Bone Loss"

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Background: *Fusobacterium nucleatum* (*F. nucleatum*; *Fn*) is a Gram-negative non-spore forming filamentous anaerobe commonly found in the oral cavity and plays an important role in dental biofilm formation and periodontal disease development. *F. nucleatum* encodes a novel adhesin protein, FadA, which is a potent virulence factor that facilitates the bacterial binding and invasion of host cells. The role of FadA in *F. nucleatum* mediated periodontal tissue destruction, however, is unknown. The aim of this study was to determine whether abrogation of FadA directly impacts *F. nucleatum* mediated periodontal bone loss *in vivo*.

Objective: To investigate the role of FadA adhesin in *F. nucleatum* mediated periodontal bone loss.

Materials & Methods: In order to induce periodontitis and periodontal bone loss *in* vivo, approximately 1×10^9 CFU of *F. nucleatum* wild-type 12230 were suspended in carboxymethylcellulose (CMC) and administered orally to C57BL/6 mice four times a week for 10 weeks. CMC without *Fn* was also administered as a control. The effect of FadA modulation on periodontal bone loss was assessed by inoculating C57BL/6 mice with FadA deletion mutants US1, and lam, a spontaneous mutant defective in FadA secretion and host cell binding and invasion. In order to examine periodontal bone loss *in vivo*, inoculated mice were sacrificed and maxillae were harvested, fixed in 4% paraformaldehyde (PFA) for 24 hours, and stored in 70% ethanol for ☐CT analysis. Specimens were scanned using a Scanco vivaCT 80 system (Brüttisellen, Switzerland) using machine settings of 55kVp, 145μA, and 250ms integration time. Grayscale images were reconstructed with a voxel size of 10.4μm, smoothed using a Gaussian filter to remove noise (sigma = .8, support = 1), and thresholded at 40% of the maximum grayscale value to isolate mineralized tissue. CEJ junction measurements were made manually on reconstructed images using ImageJ. Bone density measurements were calculated using standard Scanco analysis software using the same filter and threshold for the particular isolated regions of interest.

Results: Ten-week oral inoculation of *Fn* 12230 yielded significant periodontal bone loss around mesiobuccal, distobuccal, and palatal roots of murine maxillary 1st, 2nd, and 3rd molars as determine by ☐CT analysis. The greatest change in crestal bone height was observed at mesiobuccal and distobuccal roots of maxillary 1st molars. Tissue mineral density measurements demonstrated significant decrease in hard tissue density circumferentially around all maxillary molars upon *Fn* inoculation. Upon inoculation with mutants US1 and lam, a decrease in periodontal bone loss was observed, particularly around palatal roots of 1st and 2nd maxillary molars, when compared to *Fn* 12230 inoculated mice.

Conclusion: These data indicate that inoculation *F. nucleatum* alone is sufficient to induce pathogen mediated periodontal bone loss in C57BL/6 mice, and that deletion or impaired function of FadA adhesin, preventing invasion of *F. nucleatum* into host cells, may impede *F. nucleatum* mediated periodontitis and subsequent alveolar bone loss.

50"Dental Referral Outcomes of Children in Northern Manhattan Head Start"
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Background: The Center for Disease Control and Prevention reports that dental caries is the most prevalent chronic disease in children. By the time children reach kindergarten, more than 28% of them have caries. Untreated dental caries can cause pain, abscesses, systemic infection, premature tooth loss, and missed school days for children, and work days for parents. Low-income children remain disproportionately affected, with reports that 1-in-3 children with Medicaid have untreated tooth decay and 1-in-9 with three or more decayed teeth. A 2018 study of Northern Manhattan children in Early Head Start and Head Start programs showed significantly higher rates (91%) of untreated decay than the general and the minority populations (37%). Mobile van-based units offer an accessible solution by bringing dental care to children in underserved areas. When working in tandem with elementary schools, these mobile van-based units may address problems children and families face with obtaining dental care.

Objectives: To assess referral outcomes of Northern Manhattan Head Start enrollees with dental caries examined on the academic medical center mobile van-based unit.

Materials & Methods: A retrospective chart review of 777 charts was conducted of patients seen on a mobile van-based unit from 2016 – 2018, aged 2 to 5 years, with dental caries at initial examination. Patients presenting for initial examination without previous referral for caries or previous restorations were identified. Location of caries (anterior vs. posterior), date of birth, insurance, sex, initial examination date, MRN, and name were collected and coded. Follow-up data were collected from DentaQuest, Healthplex, and dental records for patients referred for caries. This data included any subsequent preventive, emergency, or restorative procedures completed within one year from referral date.

Results and Conclusions: A total of 168 patients (56% female), mean age 3.75 years, met inclusion criteria. Most referrals were followed-up within one year (n=125, 74%), but only 42 (25%) of which were completed within 6 months. The majority of treatment was preventive (n=110, 88%); 25% of the referrals were at an outside clinic (n=27) and 75% on the Mobile Dental Unit for a subsequent visit (n=83). Only 22% of patients with caries received restorative treatment within the year (n=37). For patients with both anterior and posterior caries (n=57, 34%), 61% (n=35) received preventive, 35% (n=20) received restorative, and 4% (n=2) received no treatment. There was no significant difference in follow-up between patients with anterior vs. posterior caries (P=0.48).

Discussion: Though most children received follow-up care within a year, the care was mostly preventive, and few referrals were completed within 6-months, suggesting children experience long delays to dental care from this referral source. Promotion of timely follow-up through improved communication with families upon referral may enhance caries prevention and reduce untreated decay in high-caries populations.

51 "Implementation of the 2018 Classification of Periodontal Diseases and Conditions: A Study of Dental Electronic Health Records"

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Background: The classification of periodontal diseases has undergone several modifications in the past few decades. The 1999 system that classified the major forms of periodontitis as chronic or aggressive was shown to be based on several erroneous postulates, resulting in a substantial overlap between the major diagnostic categories, and was difficult to apply in everyday clinical practice. The recent classification developed by the 2018 World Workshop utilizes a two-vector system defined by Stage and Grade. Stage can range from I through IV, it not only reflects the severity of the disease and the complexity of management of the case, but also incorporates the number of teeth lost due to periodontitis. Grade ranges from A through C and reflects additional biological dimensions of the disease, including an assessment of periodontitis progression based on patient history, the risk for future progression and the presence of risk factors that may negatively affect treatment outcomes.

Objective: The purpose of this study was to use dental Electronic Health Records (dental EHRs) to retroactively apply the criteria of the new classification to a subset of dental EHRs of patients previously diagnosed with one of the two major forms of periodontitis (chronic or aggressive). The analyses aimed at: (i) assessing the feasibility of assigning a diagnosis according to the new classification based on existing information included in available dental EHRs, and (ii) comparing the distribution of Stage and Grade among patients earlier diagnosed as suffering from chronic or aggressive periodontitis.

Materials and Methods: After approval by the Columbia University Irving Medical Center Institutional Review Board, dental EHRs in the Axium Patient Management System were reviewed. A random 10% subset of all patients referred to the Post-doctoral Periodontics Clinic, Columbia University College of Dental Medicine over a period from 6/1/2011 (the inception of dental EHRs at CDM) to 6/30/2018 were examined by a single examiner. Using available EHR data including demographic variables, medical history, smoking status, full-mouth radiographs and periodontal charts, a diagnosis was assigned for each patient according to both the previous and the new classification of periodontitis.

Results: Out of the 336 patient records examined, 132 patients were found to present with gingivitis, while 204 patients presented with periodontitis (mean age 42.3 years, age range 13-90, 58% females, 23% smokers and 22% with diabetes mellitus). Amongst these, 136 patients (66.6%) were diagnosed as having chronic periodontitis (mean age 48.5 years, age range 37-90, 60% females, 11% smokers and 15 % with diabetes), while 68 patients (33.4%; mean age 28.7 years, range 13-55, 57% females, 12% smokers, 7% with diabetes) were diagnosed as having aggressive periodontitis. Of the patients categorized as presenting with chronic periodontitis, 7% were classified according to the new system as Stage I, 65% as Stage II, 21% as Stage III and 7% as Stage IV; 11% of these were classified as Grade A, 63% as Grade B, and 26% as Grade C. Of the patients classified as having aggressive periodontitis, none were classified with Stage I periodontitis, 10% were diagnosed with Stage II, 47% with Stage III and 43% with Stage IV periodontitis; 100 % of them were classified as Grade C, primarily based on the percent bone loss/age ratio at the site of most severe destruction. Approximately 33% of the patients qualified as Grade C due to presence of uncontrolled diabetes or heavy smoking.

Conclusions: The study demonstrated that it is feasible to retroactively reassign a diagnosis of periodontitis according to the principles of the new classification using available information included in dental EHRs. The majority (85%) of patients originally diagnosed with chronic periodontitis were re-classified as having either Stage II or Stage III disease; 90% of those originally diagnosed with aggressive periodontitis were re-classified to either Stage III or Stage IV disease, and all of them were considered to suffer from Grade C periodontitis. The new classification system appears to be better aligned with the principles of personalized medicine and to reflect in greater detail the multifaceted nature of periodontitis.