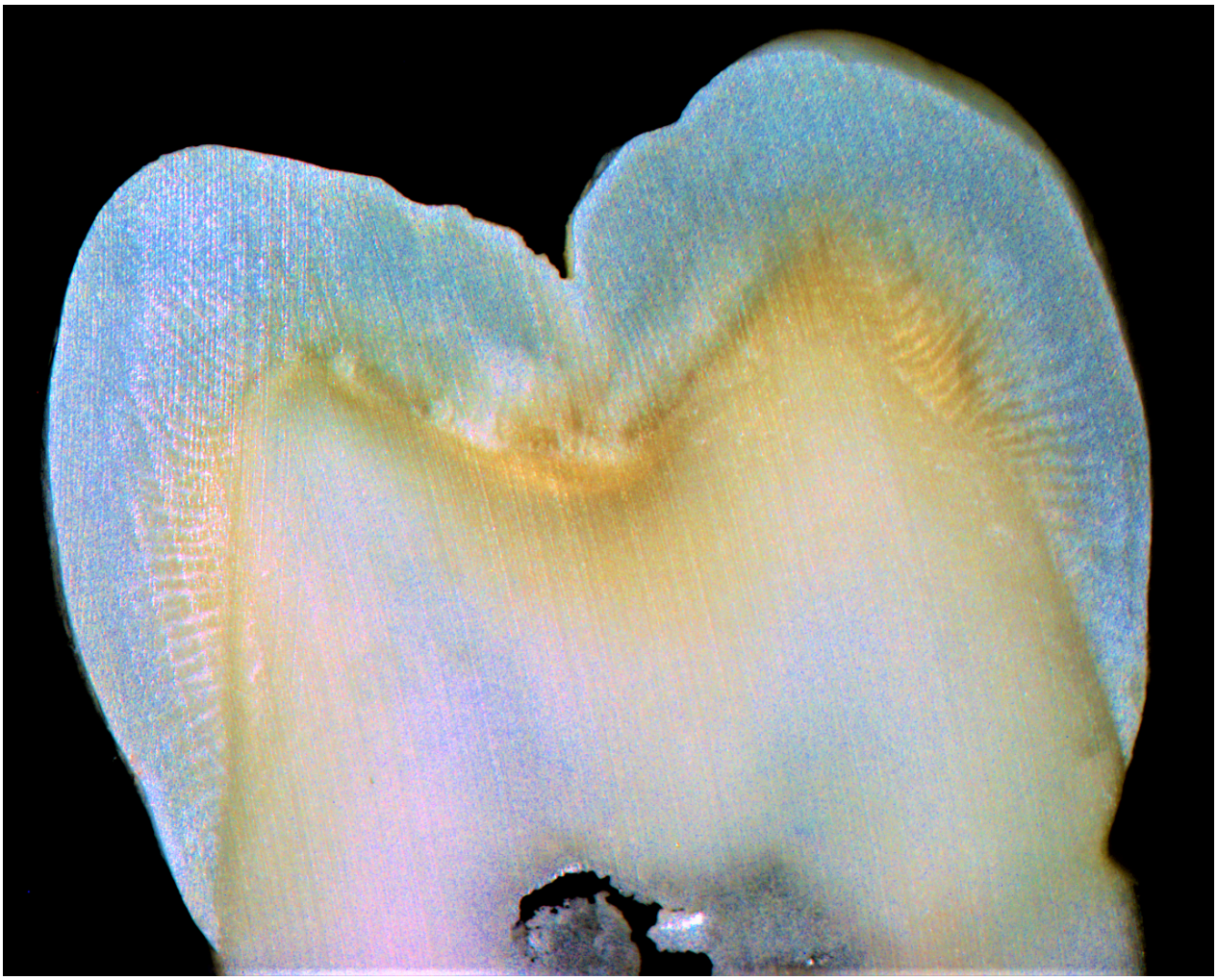
UNC | ADAMS SCHOOL OF DENTISTRY



UNC-CH Adams School of Dentistry

36TH RESEARCH DAY

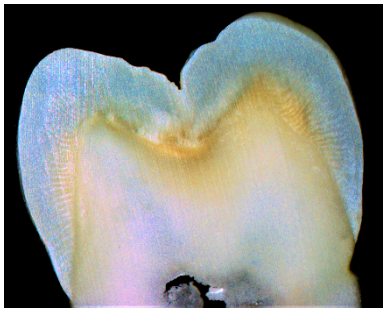
FEBRUARY 12, 2020

Contents

Front cover image taken by:

Ian Stewart, DDS3 Student, Adams School of Dentistry, University of North Carolina at Chapel Hill

Image of a 1.5mm thick, mesio-distal section of a sound premolar tooth taken with a Nikon SMZ-745T digital stereomicroscope



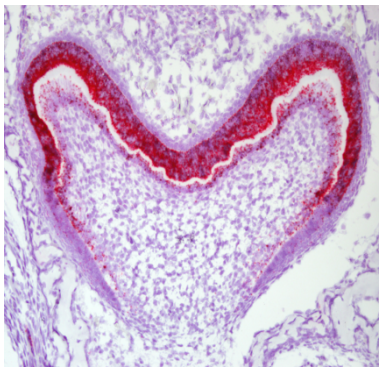
Back cover image taken by:

Sing-Wai Wong, Periodotology Resident, Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

"Expression pattern of Wnt10a during tooth morphogenesis"

RNAscope in situ hybridization of Wnt10a (red) in the epithelial and adjacent mesenchymal cells at the cervical region of a tooth germ at post-natal day 2

(Chosen as Journal of Dental Research March 2020 cover image)



Dear Colleagues,

We would like to welcome <u>everyone</u> to the 36th Annual Dental Research Day.

As announced in January, the Adams School of Dentistry's Office of Research has been newly branded as the *Office of Discovery and Innovation*. Here at the Adams School of Dentistry, we are committed to inspiring, creating and supporting all aspects of Discovery and Innovation. This is highlighted by the diverse, inspiring and high-quality accomplishments of our students, faculty, staff, research fellows and visiting scholars being shared at the Annual Dental Research Day.

It is clear from the array of work to be presented, that investigators within the School interact and collaborate with investigators on the UNC-CH campus, as well as with leading investigators and institutions elsewhere in the United States and abroad. Indeed, we are very excited to have several individuals from other units on campus as well as colleagues from the School of Dental Medicine at East Carolina University attending and participating in the day's activities.

In addition, to 86-oral and poster presentations, the day's events will include a keynote address by Dr. Loboa, PhD, the Vice Chancellor for Strategic Partnerships, Dean and Ketcham Professor in the College of Engineering at the University of Missouri, Columbia. Specifically, she will discuss approaches in her lab to elucidate and optimize biomimetic materials and mechanical stimuli for tissue engineering and regenerative medicine applications using human adipose derived stem cells. In addition, there will be six Lunch & Learns as well as five Hands on Workshops in which attendees can participate, whereby the topics are as diverse as the interests and expertise of our attendees.

It is our hope that you enjoy the day's activities designed to promote the fellowship of Discovery and Innovation and crafted by the organizing committee which includes the North Carolina Section of the American Association of Dental Research and the local chapter of the Student Research Group.

We are excited to share in the day's experiences with each of you,

Shannon Wallet

Shannon Wallet, PhD
Associate Dean for Discovery and Innovation

Scott S. De Rossi, DMD, MBA
Dean and Professor,
Adams School of Dentistry

Dear Colleagues,

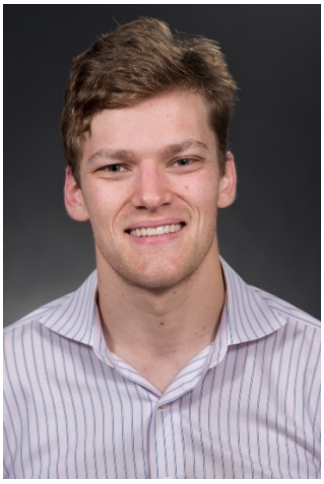
We are pleased to welcome you to the 36th UNC Adams School of Dentistry Research Day. It is a day of celebration and sharing of our research endeavors for patient benefit. Research Day enables students, trainees of all levels, faculty, staff, visiting scholars, alumni and exhibitors to engage with one another and foster stimulating discussion on the latest cutting-edge research.

The North Carolina Section of the American Association for Dental Research (NC-AADR) and the local chapter of the Student Research Group are excited to see this historic event continue to grow from strength-to-strength. We have 174 registrants with more expected to register on the day. This year registrants can claim up to 8 hours of continuing dental education credits. We have 86 poster and oral presentations from dental students, masters and PhD students, post-doctoral fellows and associates, staff and faculty members. The research presented covers a variety of themes, including biomaterials and dental materials, cancer biology, craniofacial, skeletal and oral biology and disease, and education.

We are excited to have Dr. Loboa as our keynote speaker. She is the 11th dean of the College of Engineeting at the University of Missouri, Columbia. Dr. Loboa will be speaking on regenerative medicine and precision health, which aligns well with our School's strategic plan and mission. There are also numerous lunch and learn sessions and workshops designed to support our research goals. This day would not be possible without the generosity from our sponsors and we encourage you to visit the exhibitor tables. Finally, please do not forget to complete the research day quiz in exchange for a special gift!

We hope you enjoy the vibrancy of the day and look forward to another successful scientific event.

Sincerely,



Colin LaPrade
Co-President
Student Research Group

Sarah Liebkemann
Co-President
Student Research Group

Rishma Shah, PhD, MS, BDS
President
NC-AADR

36th Research Day Keynote Presentation

Kirkland Auditorium, Koury Oral Health Sciences Building,
UNC Adams School of Dentistry
12pm-1pm, Wednesday February 12, 2020

Regenerative Medicine and Precision Health from UNC to MIZ

Elizabeth Loboa, Ph.D.
Vice Chancellor for Strategic Partnerships
Dean and Ketcham Professor, College of Engineering
University of Missouri, Columbia

In this presentation, Dr. Loboa will first discuss approaches in her lab to elucidate and optimize biomimetic materials and mechanical stimuli for tissue engineering and regenerative medicine applications using human adipose derived stem cells (hASC). Human ASC are a particularly promising cell source for functional tissue engineering applications due to their multilineage differentiation potential and their abundance and ease of harvest relative to many other cell types. Focus will be on work she initiated while in the Joint Department of Biomedical Engineering at UNC-Chapel Hill and NC State on regeneration of skin and musculoskeletal tissues; and, approaches to wound care and tissue regeneration while combating multi-drug resistant bacteria, in particular methicillin resistant *Staphylococcus Aureus* (MRSA).

To conclude her talk, Dr. Loboa will share her work on the NextGen Precision Health Institute at the University of Missouri (Mizzou). The NextGen Precision Health Institute, a $220.8 million, 265,000 sq ft facility focused on precision health bench-to-bedside research in cancer, vascular, and neurological conditions, is the UM System's top capital priority. Opening in the fall of 2021 on Mizzou's campus, it will be an incredible new home for interdisciplinary collaboration, industry partnership and medical discovery.

Dr. Loboa has made important contributions to the field of tissue engineering and regenerative medicine, with particular impact in mechanobiology, 3D printing and textile based approaches to tissue engineering. Her work has been funded by the National Science Foundation, Orthopedic Research and Education Foundation, and the National Institutes of Health. She has published over 275 peer-reviewed journal articles, conference proceedings and book chapters in her field. She has held multiple leadership roles in her profession including service on editorial boards for five scientific journals, multiple boards of directors and chair of many conferences and professional societies. Dr. Loboa has been recognized with honors including the UC Davis Distinguished Engineering Alumni Award, NCSU Chancellor's Innovation Award, Insight Into Diversity Giving Back Award, NCSU Faculty Scholar Award, UK-US Stem Cell Collaboration Development Award and Stanford University Distinguished Alumni Scholar Award.

Schedule of Events

Time	Activity and Location
7 – 8 a.m.	**Poster and Vendor Set-up** Atrium and Main Street, Koury Oral Health Sciences Building
8 a.m.	**Dean's Welcome Breakfast and Registration** West Lobby, Koury Oral Health Sciences Building
8 a.m. – 4:30 p.m.	**Exhibition Open**
8:30 – 8:40 a.m.	**Welcome and Opening Remarks** **Scott De Rossi** DMD, MBA, Dean **Colin LaPrade and Sarah Liebkemann** Co-presidents, Student Research Group **Rishma Shah,** PhD, BDS, MSc Chair, Research Day Organizing Committee West Lobby, Koury Oral Health Sciences Building
8:45 – 10:15 a.m.	**Oral Presentations** Room assignment in program *General attendance*
10:15 – 11:45 a.m.	**Poster Presentations and Coffee** Atrium and Main Street, Koury Oral Health Sciences Building *General attendance*
12 – 1 p.m.	**Keynote Presentation: Regenerative Medicine and Precision Health** **Elizabeth Loboa** PhD, MSE, BS Dean, College of Engineering at the University of Missouri Kirkland Auditorium, Koury Oral Health Sciences Building *General attendance*
1:15 – 2:15 p.m.	**Lunch and Learn Sessions** Details in the program (*By registration only)*
2:30 – 4:30 p.m.	**Workshops** Details in the program (*By registration only)*
4:30 p.m.	**Submit Research Day Quiz Card and Receive Gift** Registration Desk, Koury Oral Health Sciences Building

Save the Date!

Awards Ceremony sponsored by Dental Foundation of North Carolina

Thursday, Feb. 13 from 6:30 – 8.30 p.m.
Tobacco Road Sports Cafe, 1118 Environ Way, Chapel Hill, NC 27517
Snacks and beverages provided, registration required.

Oral Presentations

Session 1: Cancer Biology/Oral Cancer; Population and Epidemiology

G502, Koury Oral Health Sciences Building

Abstract #	Time	Presenter	Title
14	8:45 a.m.	William Seaman*	Periodontal Pathogens Reactivate EBV+lymphocytes Facilitating EBV Transfer To Oral Keratinocytes
71	9 a.m.	Lara Heimisdottir*	Metabolomics Insights in Early Childhood Caries
72	9:15 a.m.	Kevin Moss	Complex Periodontal Phenotype: GWAS Meta-Analysis of Clinical Periodontal Measures in Homogenous Subgroups
73	9:30 a.m.	Anne Sanders	Impact of Treatment Expectation on Placebo Response and Analgesic Efficacy in a Randomized Controlled Trial

Session 2: Tissue Repair and Regeneration/Wound Healing; Social Science

G411, Koury Oral Health Sciences Building

Abstract #	Time	Presenter	Title
86	8:45 a.m.	Ivette Daly	Management of Traumatically Luxated Permanent Teeth: A Retrospective Study
74	9 a.m.	Catherine Campbell	Understanding Factors Influencing Young Orthodontist Career Decisions
75	9:15 a.m.	Philip Worthington	Stress and Coping among Predoctoral and Advanced Dental Education Students/Residents
76	9:30 a.m.	Jennifer Crisp	Influences on Dentists' Adoption of Non-Surgical Caries Management Techniques for Children
77	9:45 a.m.	Anastassia Dokova	North Carolina Providers' Perspectives On Tooth Autotransplantation For The Replacement Of Missing Teeth
78	10 a.m.	Judith Beck*	Student Wellness in Dental Hygiene Programs

Session 3: Craniofacial, Skeletal and Oral Biology and Disease; Imaging and Therapeutic Modalities

G405, Koury Oral Health Sciences Building

Abstract #	Time	Presenter	Title
33	8:45 a.m.	Adam Lietzan*	β-glucuronidase from *Tannerella forsythia* – An Enzyme Associated with Periodontitis
34	9 a.m.	Michael Miao*	Reactive Oxygen Species Regulate Fibronectin Fragment-Induced MAPK Signaling Through NADPH Oxidase 2 and Integrin Endocytosis
35	9:15 a.m.	Marta Musskopf*	The Minipig Implant Intra-oral Model: Clinical and Radiographic Characteristics
36	9:30 a.m.	Phillip Hamilton*	Comparison of Open Bite Closure Outcomes with Clear Aligner vs. Skeletal Anchorage Treatment
37	9:45 a.m.	Matthew Pastewait*	3D Morphometric Quantification of Maxillae and Palatal Defects for Patients with UCLP via Image Auto-Segmentation
52	10 a.m.	John Zermeno	Comparison of Regional Superimposition Techniques: Accuracy and Precision of Methodologies

* Turner Award finalists

Poster Presentations

10:15 – 11:45 a.m.

Atrium and Main Street, Koury Oral Health Sciences Building

Biomaterials/Dental Materials

Abstract #	Presenter	Title
1	Amir Taha	Minimally Invasive Treatment For Tooth Discoloration – Follow up Case Report
2	Caitlin Baker	Dental Fear in Pediatric Patients Treated with Silver Diamine Fluoride: A Preliminary Report
3	Stephen Treacy	Alternative Esthetic Anterior Primary Tooth Crowns and Changing Provider Preference
4	Hanan Elgendy	Evaluation of Light Scattering Among Dental Tissues and Nano-Filled Composite
5	James Goglia*	Mouthguard Use in NCAA Basketball Programs
6	Basheer Alsayed*	Effect of Delayed Photo-polymerization on the Bond Strength of Dual-polymerizing Resin Cements
7	Savita Gupta	Monolithic Zirconia Partial Coverage Restorations: An In-Vitro Chewing Simulation
8	Briana Brazile	A Comparison Between Conventionally and Digitally Fabricated Dentures at UNC; A Retrospective Study

Cancer Biology/Oral Cancer

Abstract #	Presenter	Title
9	Alec Bankhead*	Malignant Lymphoproliferative Disorders Affecting the Oral Cavity: A Multi-institutional report
10	Kevin Byrd	Unique Roles for p53 Mutations in Oral Epithelial Stem Cells
11	Adele Musicant*	Development and Characterization of a Tractable Genetically Engineered Mouse Model of Salivary Mucoepidermoid Carcinoma

12	Kshitij Sharma*	CUDC-101 Potently Overcomes EGFR Inhibitor Mono-therapy Resistance in MEC
13	Aatish Thennavan*	Molecular Signatures of In-situ to Invasive Breast Cancer Progression: An Integrated Mouse and Human Study

Craniofacial, Skeletal and Oral Biology and Disease

Abstract #	Presenter	Title
15	Daniela Vivaldi*	Self-Reported Non-Pharmacological Treatments Differ between Clusters of Orofacial Pain Patients
16	Mustafa Girnary*	Caspase-1-mediated Periodontal Bone Destruction is Sex-dependent
17	Marla O'Neal	Analysis of Osteoclasts in a Periodontitis Model
18	Reid Risinger	Incidence Of Mid-treatment Posterior Open Bite Developed In Deep-bite Patients Treated With Clear Aligner Therapy
19	Pegah Khosravi-Kamrani	Categorizing Cl III Subtypes, Treatment Modes, and Treatment Outcomes
20	Koby Martin	Sex impact of Caspase-1 Inhibition on Inflammatory Cell Migration in Experimental Periodontitis
21	Scott Philips	Mandibular Alveolar Bone Remodeling Following Maximum Incisor Retraction
22	Adam Hoxie	MicroCT as Reference Standard for ICDAS and QLF-D
23	Nathan Yip*	Association of Apical Periodontitis with HbA1c Levels in Hospital Patients
24	Colleen Holewa	Neurosensory Disturbance of the Lingual Nerve after Bilateral Sagittal Split Osteotomy
25	Farhnaz Fahimpour*	The Peripheral Blood Leukocytes Epigenetic Profile of Electronic Cigarette Smokers: A Clinical Pilot Study

26	Sing-Wai Wong*	Unravelling the Role of Autophagy Machinery in Osteoclastogenesis
27	Lisa Metzger	*Pseudomonas aeruginosa* Promotes the Survival of Strict Anaerobic Pathogens Under Aerobic Growth Conditions
28	Matthew Pendleton	Inhibitory Effect of Streptococci on the Growth of Endodontic Pathogens *F. nucleatum* and *P. gingivalis*
29	Trevor Oliverson	Clinicians Difficulty Predicting Post-Procedure Acute Pain Levels
30	Chandler Conner	Anatomical Variations of Mental Foramen Detected by CBCT. A Case Report
31	Blaine Radley	Molecular Analysis of Tooth Eruption Disorders
32	Deepti Karhade	An Automated Machine Learning Classifier for Early Childhood Caries Prediction

Education

Abstract #	Presenter	Title
38	Jadesola Giwa	Debunk the Junk: A Student-Driven Interprofessional Event
39	Jadesola Giwa	Qualitative Evaluation of a Group-Messaging Application In Medicine And Dentistry: Educators' Perspectives (Phase 1)
40	Jadesola Giwa	Could Collaboration between Emergency Room Clinicians and Dentists Effectively Treat Patients with Acute Dental Pain?
41	Jennifer Harmon	Analysis of an Innovative Dental Hygiene Clinical Evaluation System
42	Amanda Allen*	Promoting Early Childhood Oral Health in Clinical Practice: Development of a Smartphone Application
43	Andrea Faust*	Teaching Methodologies for Implementation of Ergonomic Operator and Patient Positioning
44	Caroline McLeod*	Dental and Dental Hygiene Students' Knowledge and Attitudes Regarding Teledentistry

45	Bethany Fearnow	Building a Foundation: Implementation of an Early Standardized Patient Encounter
46	Alice Jamison	Assessing Oral Health Content in Non-dental Professional Association Websites

Imaging and Therapeutic Modalities

Abstract #	Presenter	Title
47	Colin LaPrade	Intraoral Radiographs – A Comparison of Dose Reduction with Collimation and Thyroid Shielding
48	Ian Stewart*	SIOT And Transillumination In Detection Of Proximal Caries
49	Hudson Spangler	Feasibility of Serving Personalized 3D Dentition Models for Communicating Tooth Surface-Level Conditions
50	Jessica Dillon	A Comparison of Contemporary Portable X-ray Systems
51	Manal Hamdan	Detecting Apical Lesions Using Deep Learning Technology: A Pilot Study

Population and Epidemiology

Abstract #	Presenter	Title
53	Zachary Burk*	Developmental Defects of the Enamel Among Preschool-Age Children
54	Emily Imes	Parents' Education Influences their Reports of Children's Oral Health Status
55	Kamaira Philips*	Periodontal Disease, Undiagnosed Diabetes and Body Mass Index: Implications for Diabetes Screening by Dentists
56	Dominick Glavich*	Prevalence of Peri-implantitis and Peri-implant Mucositis: A Review of Electronic Health Records
57	Chinelo Eke	An Environmental Scan of Dental Medicaid Coverage for Pregnant Women by State

58	Kayla Kopczynski	Oral Health-Related Quality of Life in Children Treated with Silver Diamine Fluoride: A Preliminary Report
59	Wade Townsend	National Comparison of Pediatric Dental Treatment Decisions by Practice Environment
60	Beatrice Williams*	Lifestyle Factors that Effect Self-Perceived Health in HIV+ Individuals Receiving Comprehensive Dental Care
61	Savannah Puett*	The Intersection of Prenatal Oral Health Care Utilization and Dental Education: Results and Policy Implications
62	Stephanie Companioni*	Preparedness Level of Middle and High School Athletic Trainers in Managing Dental and Orofacial Injuries
63	Meredith Davis	Overweight/Obesity and Dental Caries Among Preschool-age Children in North Carolina
64	Miguel Simancas-Palleres	Derivation and Description of Clinical Subtypes of Early Childhood Caries
65	Poojan Shrestha*	Spatial Analysis of Unrestored Early Childhood Caries in North Carolina
66	Yu Gu*	Development of a Novel Imputation Method for Missing Fluoride Measurements in a Community-Based Epidemiologic Study
67	Robin Ni	Over-the-counter Medication Use in a Community-based Sample of Preschool-age Children
68	Roxanne Dsouza	A Qualitative Interprofessional Approach to Older Adult Outpatient Clinical Care
69	Hunyong Cho	Biofilm Metagenomics and Metatranscriptomics in Early Childhood Caries
70	Morgan Hess	Building a Business Model to Implement Childhood Oral Care Into General Dentistry Practices

Tissue Repair and Regeneration/Wound Healing

Abstract #	Presenter	Title
79	Babak Yousefi*	Molecular Characterization of Irreversible Pulpitis
80	Coco Roening*	Geographical Variations in Microbiota from Immature Teeth with Necrotic Pulp
81	Christopher Ammons*	Outcome Assessment with Necrotic Pulp and Apical Periodontitis Treated with Long-Term Calcium Hydroxide
82	Natalia Besada*	DNA-Methyltransferase Inhibitors Effect on Gingival Epithelial Barrier Function
83	Jennifer Rubin*	A Multimodal Analgesic Protocol Moderating Acute Pain Levels After Third Molar Removal, an Exploratory Study
84	Lauren Katz*	Investigation of Regenerative Capacity and Molecular Profile of Craniofacial Muscle
85	Vinícius de Paiva Gonçalves*	Hesperidin Compromises In Vitro Osteoclastogenesis Process in RAW 264.7 Cells

* Turner Award finalists

Lunch and Learn Sessions

1:15 – 2:15 p.m.

Registration required

Lunch and Learn Session	Location
Session A: Digital Dentistry and 3-D Printing for Prosthodontic and Implant Research and Education **Presenter:** Sompop Bencharit, DDS, MS, PhD Department of General Practice, School of Dentistry, Virginia Commonwealth University **Learning Objectives:** a) Understand the current digital workflow in treatment planning and implant placement for restorative dentistry b) Appreciate the utility of in-office 3-D printing c) Be aware of predoctoral and postdoctoral research utilizing in-office 3-D printing	G405 Koury Oral Health Sciences Building
Session B: How Foundations Can Fund Your Research Project **Presenters:** Diane Royle Director of Strategy, Proposal and Award Services UNC Office of Corporate and Foundation Relations Michelle Arroyo Manager of CFR Prospect Management and Administration UNC Office of Corporate and Foundation Relations **Learning Objectives:** a) Understand the role of foundations in supporting research b) Appreciate the process of applying for foundation funds through examples	G508 Koury Oral Health Sciences Building

Lunch and Learn Session	Location
Session C: How to Manage Your Research Project **Presenter:** Susan Pusek, DrSc Director, Education Programs NC Translational and Clinical Sciences Institute **Learning objectives:** a) Understand the importance of project management for success b) Apply skills of project management to managing one's research project	G411 Koury Oral Health Sciences Building
Session D: Tips on the IRB Process **Presenter:** Kim Boggess, MD Professor, Maternal-Fetal Medicine Chair, UNC-CH IRB Committee D **Learning Objectives:** a) Appreciate the importance of the IRB process b) Learn to navigate the IRB submission process	3615 Koury Oral Health Sciences Building
Session E: Educational Research and Scholarship **Presenters:** Kimon Divaris, DDS, PhD Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill Michael Wolcott, PharmD, PhD, BCPS Division of Oral and Craniofacial Health Sciences, UNC Adams School of Dentistry Division of Practice Advancement and Clinical Education (PACE), UNC Eshelman School of Pharmacy **Learning Objectives:** a) Describe the types and scope of educational research b) Appreciate opportunities for the conduct of educational research c) Understand relevant resources and avenues for dissemination, including scholarly presentations and publications	G502 Koury Oral Health Sciences Building

Workshops

2:30 – 4:30 p.m.

Registration required

Workshop	Location
Session A: Find Money for Your Research Project **Presenters:** Nathan Blouin, MBA, CRA Director, UNC Office of Research Development David Carroll, PhD Director, Research Funding Development NC TraCS **Learning Objectives:** a) Appreciate the use of funding databases to find money to support your research b) Become familiar with searching for funding opportunities within the relevant databases	G411 Koury Oral Health Sciences Building
Session B: How to Pitch You and Your Research **Presenters:** Dr. Rahima Benhabbour, PhD Assistant Professor, UNC-NCSU Joint Biomedical Engineering Department, Co-Founder AnelleO, Inc. Dr. Rima Janusziewicz, PhD Postdoctoral Fellow, UNC-NCSU Joint Biomedical Engineering Department, Co-Founder of AnelleO, Inc. Andrew Kant, MS Associate Director, FastTraCS at NC TraCS Institute **Learning Objectives:** a) Appreciate the importance of the two minute elevator pitch b) Develop your own elevator pitch in this workshop and receive feedback	3615 Koury Oral Health Sciences Building

Workshop	Location
Session C: How to Give a 10 Minute Scientific Presentation **Presenter:** Susan Pusek, DrSc Director, Education Programs NC Translational and Clinical Sciences Institute **Learning Objectives:** a) Appreciate the structure of a short scientific presentation b) Develop skills to deliver a short scientific presentation	**5401** **Koury Oral Health Sciences Building**
Session D: Aligning Expectations and Maintaining Effective Communication **Presenters:** Bradley Gaynes, MD, MPH Professor, Psychiatry Faculty, KL2 Program NC TraCS Jennifer Webster-Cyriaque, DDS, PhD Professor, Adams School of Dentistry and School of Medicine Director, Viral Oral Infections in Immunosuppression and Cancer (VOIICe) PI and Director, Mechanisms of Translation Realizing Discovery and Understanding the Pipeline CTSA Post-Doctoral Program University of North Carolina Chapel Hill **Learning Objectives:** a) Appreciate the importance of aligning expectations of the team for success b) Appreciate the importance of effective communication c) Develop effective communication skills through case studies	G508 Koury Oral Health Sciences Building
Session E: Digital dentistry and 3-D printing for prosthodontic and implant research and education **Presenter:** Sompop Bencharit, DDS, MS, PhD Department of General Practice, School of Dentistry, Virginia Commonwealth University **Learning Objectives:** a) Understand the current digital workflow in treatment planning and implant placement for restorative dentistry b) Learn the skills of in-office 3-D scanning and printing	G502 Koury Oral Health Sciences Building

Abstracts

Biomaterials/Dental Materials

(1) Minimally Invasive Treatment for Tooth Discoloration – Follow up Case Report

Taha A[1], Elgendy H[2]

[1]DMD Candidate 2021, School of Dental Medicine, East Carolina University; [2]Department of General Dentistry, Division of Operative, School of Dental Medicine, East Carolina University

Objectives: Non-vital bleaching is a minimally invasive technique used to treat discoloration of teeth post-endodontic treatment. The aim of this case report is to demonstrate the non-vital bleaching technique in maxillary anterior teeth.

Methods: Non- vital bleaching technique was used on a maxillary central incisor after applying the rubber dam isolation. Vitrebond, a light-cured, resin-modified glass ionomer, was used as a barrier material for the root canal obturation. Sodium perborate mixed with sterile water was placed in the access cavity and sealed with intermediate restorative material. This process was repeated twice with improvements shown over a one-month period. Proper care and follow ups using radiographic images will be needed to ensure no post-operative complications occur, such as cervical root resorption.

Conclusion: The choice of treatment of tooth discoloration should start with knowing the etiology. Minimal invasive treatment is always encouraged to get an ultimate outcome for esthetic cases of intrinsic stains.

(2) Dental Fear in Pediatric Patients Treated with Silver Diamine Fluoride: A Preliminary Report

Baker C[1], Kopczynski K[1], Purvis R[2], Moore D[2], Meyer BD[1]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [2]Charlotte Pediatric Dentistry, Charlotte, NC, United States.

Objective: The purpose of this study was to evaluate the effects of SDF treatment on dental fear. Specifically, we compared dental fear before and after various caries management strategies while accounting for demographic information. The final results of this study should provide novel insight into the effects of different caries management strategies on dental fear.

Methods: This cross-sectional report was conducted at a large multi-center private practice in Charlotte, North Carolina. Child and family demographic information (such as age in years, gender, race, parent education level, family income, and dental insurance status) as well as dental treatment needs was collected. We used the Modified Corah's Dental Anxiety Scale (MDAS) to measure dental fear in both the adult caregiver and the child patient. All study data were recorded using REDCap. We compared pre-treatment responses across three major categories: (1) in-office treatment with SDF, (2) conventional, in-office restorative/surgical treatment, and (3) restorative treatment using hospital-based general anesthesia. Descriptive statistics (means, standard deviations, and frequencies) and bivariate methods (student t-tests and Pearson chi-squared tests, as indicated) comprised the analysis.

Results: The three treatment groups were similar across all child and family demographic domains except for age, where children treated with SDF were significantly younger than the other groups. Children treated with general anesthesia had the most treatment needs. There

was no significant difference in MDAS scores among the three treatment groups for both adult caregivers and children. Among all groups, anxiety was highest when about to receive an injection and have a “tooth drilled”, and these were highest among children planned for general anesthesia.

Conclusions: This pre-treatment assessment shows no demographic or dental fear differences aside from age among the three treatment groups. However, the study remains ongoing and comparisons about the post-treatment effects of treatment on the MDAS score cannot be made.

(3) Alternative Esthetic Anterior Primary Tooth Crowns and Changing Provider Preference

Treacy ST[1], Meyer BD[2], Saemundsson SR[2], Wright JT[2]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Full-coverage crowns are one of the most common treatments performed on children with early childhood caries. In the past decade, pre-fabricated zirconia crowns (ZC) have entered the market as an esthetic alternative to composite resin strip crowns (CRC) and pre-veneered stainless-steel crowns (PVSSC). This study evaluated the prevalence and distribution of different anterior primary esthetic crowns placed at a single teaching institution.

Methods: A retrospective cross-sectional chart review study design was used. Children receiving anterior primary tooth restorations and treated using general anesthesia at the University of North Carolina at Chapel Hill in calendar years 2016 and 2017 were studied. The inclusion criteria included those younger than 6 years and those who had at least one anterior tooth restored. Data collected included provider (resident vs. faculty), age of child at treatment, year of treatment, and crown type. Descriptive statistics and bivariate methods formed the basis of analysis.

Results: Over the study period, 379 children (n=1294 teeth) were treated under general anesthesia and had at least one anterior tooth restored. The mean age of subjects was 3.46 years old (SD=1.29). Faculty and residents each treated 50% of subjects. Among treated teeth, 34% received ZC, 57% received CRC, and 9% received PVSSC. Residents were significantly more likely to place CRC (74.7%) and faculty were significantly more likely to place ZC (42.7%; $p<0.001$). From 2016 to 2017, the use of PVSSC and CRC significantly decreased (78% and 21%, respectively), and the use of ZC significantly increased (100%, $p<0.001$).

Conclusions: The change in distribution of PVSSC, CRC, and ZC placed from 2016-2017 suggests an increased preference for ZC. Faculty were more likely to use ZC, while residents preferred CRC. This project is part of a larger study exploring clinical retention rates and parental satisfaction with full-coverage restorations placed on carious anterior primary teeth.

(4) Evaluation of Light Scattering Among Dental Tissues and Nano-Filled Composite

Elgendy H[1], Maia RR[2], Skiff F[3], Denehy G[2], Qian F[4]

[1]Department of General Dentistry, Division of Operative, School of Dental Medicine, East Carolina University, [2]Department of Operative Dentistry, College of Dentistry, University of Iowa, [3]Department of Physics and Astronomy, College of Liberal Arts & Sciences University of Iowa, [4]Division of Biostatistics and Research Design, Iowa Institute for Oral Health Research and Department of Preventive and Community Dentistry, College of Dentistry University of Iowa

Objective: This study used LASERs with a spectrophotometer to compare the light propagation; absorption (A), transmittance (T), and scattering anisotropy coefficient (g) in dental tissues and nano-filled resin-based composites. This study used three distinct incremental build-up techniques.

Method: 20 human, un-erupted, extracted third molars were used. The samples were randomized into four experimental groups. The Control Group: sound samples with no prep; the Technique 1 group (T1): one shade, B1B; the Technique 2 group (T2): two-shades, Dentin and Enamel; and the Technique 3 group (T3): three shades, Dentin, Transparent, and Enamel. Each specimen was irradiated by three LASERs. A voltmeter recorded the light-output signal, and from this raw data, the following optical constants (A, T, g) were calculated.

Results: ANOVA, followed by a post hoc Tukey's test ($p < 0.05$), revealed that absorption and transmittance in dental tissues were significantly different when comparing the three build-up technique groups. There was also no significant difference among the three lasers for T2 and T3. There was also no significant effect of the types of experiments on the value of scattering anisotropy factor g for blue laser among the four experimental groups.

Conclusion: Within the limitations of this study, none of the build-up techniques were able to reproduce the dental tissues optical properties, and T2 and T3 resulted in a similar pattern of light propagation.

Funding ADEA COS Project Pool

(5) Mouthguard Use in NCAA Basketball Programs

Goglia JE[1], Tawil PZ[1], Saemundsson SR[2], Duqum I[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: It has been demonstrated that mouthguards (MGs) reduce the incidence of dental trauma during basketball activities. Despite these findings, the National Collegiate Athletic Association (NCAA) does not have a rule mandating MG use in basketball athletes. In basketball, the incidence of dental trauma remains high compared to other sports. The objective of this study is to evaluate the practices of MG use and trauma prevention of NCAA basketball programs across the USA, and to identify how dental trauma can be better prevented in these athletes.

Methods: A list of athletic trainer (AT) email addresses was compiled for all 1,113 schools with NCAA basketball programs. A 12-question survey was distributed to 1,105 (99%) of them. The survey aimed to evaluate how NCAA basketball program ATs approach MG usage and dental trauma prevention for their basketball athletes. Descriptive statistics and Chi-Squared analysis were completed.

Results: A total of 348 (31%) surveys were. 93% of responding ATs believe MGs help prevent dental trauma. 45% of them stated they have programs to provide MGs to their athletes. There are statistically significantly **(p=.001)** more Division I schools that provide MG's to their athletes, use custom MGs, educate their athletes on trauma, and have trained professionals fabricate the MGs (Dentist or Athletic Trainer) when compared with Division II and III.

Conclusion: Division 1 NCAA basketball programs take greater measures to provide their athletes with MGs that are professionally made when compared with Division II and Division II programs.

(6) Effect of Delayed Photo-polymerization on the Bond Strength of Dual-polymerizing Resin Cements.

Alsayed B[1], Clark W[1], Cook R[1], Sulaiman T[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objective: To examine the effect of delaying the photo-polymerization process on dentin shear bond strength (SBS) of different dual-polymerizing resin cements.

Materials and Methods: Shear bond strength of two dual-polymerizing adhesive (RelyX-Ultimate, 3M) and self-adhesive (RelyX-Unicem 2, 3M) resin cements were evaluated. Dentin specimens (n=80) were prepared for SBS test according to ISO standard 29022:2013. Teeth were randomly allocated into 8 groups based on the type of dual-polymerizing resin cement, and the photo-polymerization delay times (0-2-5-10 minutes. Irradiance measurement and calibration of the photo-polymerizing unit was done prior to each polymerization cycle. The statistical analysis was performed using linear regression to fit a model with explanatory variables for resin cement (categorical), polymerization time (continuous), and their interactions.

Results: Mean and standard deviation (SD) of dentin shear bond strength for each group are provided. The interaction between resin cement and polymerization time was highly significant ($p < 0.0001$). The variable for resin cement type was also statistically significant ($p<0.0001$). When RelyX-Ultimate was used, the dentin SBS values were higher than RelyX-Unicem2 groups.

Conclusion: Photo-polymerization time had an effect on dentin SBS, with higher bond strengths when photo-polymerization time was performed between 2 and 5 minutes with self-adhesive versus adhesive cement.

(7) Monolithic Zirconia Partial Coverage Restorations: An In-Vitro Chewing Simulation

Savita Gupta[1], Lee Boushell[1], Donovan.T[1], S. Bencharit[2], T. Sulaiman[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University Of North Carolina at Chapel Hill [2]Department of General Practice, School of Dentistry, Virginia Commonwealth

Objective: The purpose of this study was to evaluate the survival rate and marginal integrity of monolithic zirconia partial coverage restorations bonded using the APC (Air particle abrasion, primer with MDP and Composite resin) protocol.

Materials and Methods: Extracted human premolars (N=32) were randomly divided into 4 groups of eight specimens each. Preparations of specimens were as follows: Group1(control)Full Crown, Group 2; preserving 2mm F-L functional cusp width, 3mm axial height, rounded shoulder margin, Group 3: preserving 2mm F-L non-functional cusp width, 3mm axial height, rounded shoulder margin, Group 4:overlay preparation with 1.5mm occlusal reduction, 1mm axial height and 1mm wide rounded shoulder margin. All restorations were milled from CAD/CAM blocks (ZirCad, A1 LT, Ivoclar Vivadent) and had minimum occlusal thickness of 1.5mm and axial thickness of 1mm.The intaglio surface of the restorations were particle abraded (50 micron Alumina, 2Bar pressure, 10mm distance), primed with (Monobond plus) and then bonded with Multilink Automix. Each water-submerged group was subjected to dynamic loading for 1.2 million cycles (force=70N, 1.4Hz) with simultaneous thermocycling (5-55˚C, 30s dwell time) using a chewing simulator. All specimens were examined under 4.5X magnification and normal operatory lighting for evidence of failure. Debonding, and/or fracture of restorations and/or fracture within tooth material were considered modes of failure. SEM analysis were performed to see the micro cracks and marginal defects.

Results: 1 failure in Group 2 (debonding) at 632,000cycles. No failure across groups for fracture type. In group 2, SEM at 30X indicated remaining 7 samples had marginal integrity issue. None of other group had marginal integrity issue at 30X. Across at 100X and 150X No samples had crack in restorations.

Conclusions: Following a strict bonding protocol, bonding zirconia seems to be promising and durable. Occlusal contact on restoration margins should be avoided. Due to its fracture resistance, 3Y-zirconia may be considered as a desirable material for partial coverage restorations.

(8) A Comparison Between Conventionally and Digitally Fabricated Dentures at The University Of North Carolina School of Dentistry; A Retrospective Study

Brazile B[1], Matthews D[1], Solares JA[1], Clark WA[3], DeKok I[3]

[1] DDS Candidate, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objective: This study was designed to retrospectively compare digitally fabricated completed dentures placed after June 2018, when CAD/CAM dentures were introduced at the UNC Adams School of Dentistry, with conventionally fabricated dentures.

Methods: This is a retrospective chart review that evaluated UNC Adams School of Dentistry Patients via Electronic Patient Record. We extracted data for patients who received conventional dentures and had documented visits for initial impressions, border molding, maxillomandibular relations, tooth try-in, insertion and post-op. We reviewed 314 charts, from which 281 charts fit the criteria for further review. Of the 314 total charts, 33 charts were excluded due to lack of progress notes, lack of post-operative appointments or lack of data. We extracted data for 242 conventional dentures and 39 digital dentures that were fabricated at the school using Wagner protocol and Avadent for definitive prosthesis.

Results: 50% of conventionally fabricated dentures had 6 visits or more, whereas 5% of digitally fabricated dentures had 6 or more visits. On average patients receiving conventionally fabricated dentures required 2-3 post op visits; whereas patients receiving digitally fabricated dentures required 1-2 post-op visits.

Conclusion: Using appropriate and efficient digital denture protocol, digital dentures fabricated at the UNC School of Dentistry resulted in significantly less treatment visits and post-operative visits for the patient. The digital process has proven to be equally if not more effective and a more time-efficient option for the edentulous patient.

Cancer Biology/Oral Cancer

(9) Malignant Lymphoproliferative Disorders Affecting the Oral Cavity: A Multi-institutional report

Bankhead A[1], Flores A[2], Lim SO[3], Padilla R[4], Murrah V[4]

[1]School of Dental Medicine, East Carolina University, [2]Department of Surgical Sciences, School of Dental Medicine, East Carolina University, [3]UNC Hospitals, [4]Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Report the incidence of malignant hematologic neoplasms in the oral cavity according to the experience of the two oral and maxillofacial pathology institutions in North Carolina, USA.

Methods: A 10-year retrospective review was carried out in the records of patients at ECU SoDM and UNC Adams SoD. The diagnosis-based search included only lymphomas

confirmed by hematopathology. Age, sex, location of the lesion, clinical impression, initial diagnosis, and the immunohistochemical and molecular markers were recorded for each subject. All diagnoses were reviewed according to the 2016 revision of the WHO classification of lymphoid neoplasms.

Results: A total of 312 records from both institutions were reviewed. Preliminary results of 51 cases fitting the inclusion criteria are presented. Twenty-seven males and 24 females with an average age of 60.9 comprised the study population. The most common neoplasm encountered was plasma cell myeloma, followed by diffuse large B-cell lymphoma, B-lymphoblastic lymphoma, and follicular lymphoma. We encountered mostly intraosseous tumors, being the posterior mandible and posterior maxilla the most common locations. Twelve cases were identified initially as a periapical radiolucency and submitted as failed endodontic therapy. Eight cases were reclassified, according to the 2016 WHO classification system.

Conclusions: Our findings are concurrent with the existing literature regarding epidemiologic data. However, the type and location of tumors encountered do not, as the most common lymphoma in the oral cavity is diffuse large B-cell lymphoma, which typically presents in soft tissue. Knowledge of the new classification and updated diagnoses of existing data can increase awareness and improve the management and prognosis of patients with oral malignant lymphoproliferative disorders. Further analysis to include more records is needed to determine the total incidence in North Carolina.

(10) Unique Roles for p53 Mutations in Oral Epithelial Stem Cells

Byrd KM[1,2], Wagner BL[2], Piehl NC[1,2], Williams SE[1]

[1]Division of Oral & Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Pathology & Laboratory Medicine, School of Medicine, University of North Carolina at Chapel Hill

Objectives: Head and neck squamous cell carcinomas (HNSCCs) are the 6th most common cancer worldwide and are hypothesized to contain stem cells that contribute to metastasis, recurrence, and/or chemotherapeutic resistance. The most commonly mutated gene in many cancers is *TP53* (*p53*). *TP53* mutations frequently appear in the DNA binding domain (human HNSCC 'hotspots': $p53^{R175}$/$p53^{R248}$/$p53^{R273}$/$p53^{R282}$) and are thought to be gain-of-function (GOF) mutations. TP53 is activated in response to various cellular stresses; however, studies have implicated TP53 in affecting the balance between symmetric and asymmetric cell fate decisions. The aim was to test how two $p53^{GOF}$ mutations (mice: *LSL-*$p53^{R172H}$ and *LSL-*$p53^{R270H}$) affect oral epithelial stem cells (OESCs).

Methods: We first performed bulk RNAseq using $p53^{loss\text{-}of\text{-}function}$ (*LSL-*$p53^{fl/fl}$) and $p53^{GOF}$ mice combined with a constitutively-active OESC driver ($K14^{cre}$). Differentially expressed genes were confirmed using qPCR and immunohistochemistry. WT and $p53^{LOF/GOF}$ mice were exposed to 4NQO for 8 weeks and monitored for tumorigenesis. Subsequently, we used 1) proliferation assays and 2) short-term/long-term lineage tracing analyses in these models combined with a tamoxifen-inducible driver ($K14^{creER}$) and fluorescent reporter (*LSL-*$R26R^{Confetti}$) in both WT and 4NQO exposure.

Results: *LSL-*$p53^{R172H}$ and *LSL-*$p53^{R270H}$ OESCs displayed unique transcriptomes. *LSL-*$p53^{R172H}$ revealed changes associated with epithelial differentiation whereas *LSL-*$p53^{270H}$ displayed changes to DNA damage responses. When challenged with 4NQO, all *p53* mouse models displayed decreased tumor latency compared to WT. Division orientation analyses reveal an increase in asymmetric divisions only for *LSL-*$p53^{R172H}$. Longer lineage tracing experiments revealed that some clones frequently divide asymmetrically, while others greatly expand. 4NQO-challenged lineage tracing show further altered clonal dynamics compared to WT and to unchallenged *LSL-*$p53^{R172H}$ mice.

Conclusions: Common *p53* mutations in HNSCC uniquely regulate OESC fate decisions *in vivo*. Further studies of these differences will better facilitate our understanding of HNSCC initiation as well as how to precisely target therapies toward patients with these common mutations.

Funding: NIH/NIDCR K08 DE026537 (K.M.B.) and UNC Lineberger Developmental Funding Program (S.E.W.)

(11) Development and Characterization of a Tractable Genetically Engineered Mouse Model of Salivary Mucoepidermoid Carcinoma

Musicant A[1,2], Tsai Y-H[3], Gong W[3], Sheth S[4], Betancourt R[5], Henry E[1], Troutman S[6], Ovitt C[7], Wu L[8], Kissil J[6], Padilla R[9], Parker J[3], Amelio AL[1,10]

[1]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, USA; [2]Graduate Curriculum in Genetics & Molecular Biology, Biological & Biomedical Sciences Program, UNC School of Medicine, University of North Carolina at Chapel Hill, USA; [3]Lineberger Bioinformatics Core, UNC School of Medicine, University of North Carolina at Chapel Hill, USA; [4]Department of Medicine, UNC School of Medicine, University of North Carolina at Chapel Hill, USA; [5]Department of Pathology and Laboratory Medicine, UNC School of Medicine, University of North Carolina at Chapel Hill, USA; [6]Department of Molecular Medicine, The Scripps Research Institute, Jupiter, FL, USA; [7]Department of Biomedical Genetics, University of Rochester Medical Center, Rochester, NY, USA; [8]Department of Molecular Genetics & Microbiology, College of Medicine, University of Florida, USA; [9]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, USA; [10]Lineberger Comprehensive Cancer Center, Cancer Cell Biology Program, UNC School of Medicine, University of North Carolina at Chapel Hill, USA

Objectives: Mucoepidermoid carcinoma (MEC) is the most common malignancy of the salivary glands (SGs) and is characterized by the presence of a novel fusion oncogene, CRTC1/MAML2 (C1/M2). However, the cell of origin for this tumor type is unknown, limiting our understanding of MEC tumorigenesis. In this study, we sought to characterize the MEC cell of origin by generating several genetically engineered mouse models (GEMMs).

Methods: We generated several mouse strains employing cell type-specific CreER drivers to conditionally express C1/M2 along with our LumiFluor bioluminescent reporter gene in SG acinar cells (Mist1-CreER), intercalated ductal cells and serous demilune cells (Dcpp1-CreER), or all salivary ductal cells (Keratin14-CreER). We combined C1/M2 expression with p53 tumor suppressor knockout, as p53 pathway dysregulation is common in salivary MEC. Following oncogene induction, bioluminescence imaging was performed regularly and animals were monitored for 18 months or until endpoint was reached (tumor volume >2 mm^3 or >20% weight loss). SGs and tumors were analyzed histologically and assessed by qPCR for expression of C1/M2 and relevant downstream targets (e.g. PGC-1α4, IGF-1).

Results: C1/M2 induction within the acinar cell population of murine SGs does not affect SG morphology. Oncogene induction within intercalated ductal cells and serous demilune cells resulted in slight ductal hyperplasia and dysplasia. Similarly, C1/M2 induction in all SG ductal cells did not result in tumor formation but did induce a dysplastic/hyperplastic morphology in the SGs accompanied by off-target skin lesions and keratinization. However, the combination of Krt14-mediated C1/M2 ductal SG expression with homozygous p53 loss resulted in the development of SG tumors with MEC-like histologic and molecular features.

Conclusion: C1/M2-positive salivary MEC arises from a cell population within the SG duct. MEC tumor development depends on both C1/M2 expression and p53 loss. Further studies are required to reduce off-target effects of oncogene induction within the cutaneous epithelia.

Funding: Ruth L. Kirschstein National Research Service Award (NRSA) F31 Fellowship (AMM), NIH/NCI Howard Temin Pathway to Independence Award in Cancer Research R00-CA157954 (ALA), UNC Cancer Research Funds (ALA), NIH/NCATS TraCS Translational Team Science Award (ALA)

(12) CUDC-101 Potently Overcomes EGFR Inhibitor Mono-therapy Resistance in MEC

Parag-Sharma K[1,9], Nascimento-Filho CHV[2,3]*, Tasoulas J[4]*, Musicant A[5,9], Zhu Z-C[6], Twomey C[7], Liu P[4,6], Castilho R[2,8], Amelio A[1,4,9]

[1]Graduate Curriculum in Cell Biology and Physiology, Biological and Biomedical Sciences Program, UNC School of Medicine, University of North Carolina at Chapel Hill. [2]Laboratory of Epithelial Biology, Department of Periodontics and Oral Medicine, School of Dentistry, University of Michigan, Ann Arbor. [3]Genetics and Molecular Biology Research Unit, Department of Molecular Biology, School of Medicine of São José do Rio Preto, São Paulo, Brazil. [4]Lineberger Comprehensive Cancer Center, UNC School of Medicine, The University of North Carolina at Chapel Hill. [5]UNC Biological and Biomedical Sciences Graduate Program, University of North Carolina at Chapel Hill. [6]Department of Biochemistry and Biophysics, The University of North Carolina at Chapel Hill. [7]Department of Biology, The University of North Carolina at Chapel Hill. [8]University of Michigan Comprehensive Cancer Center, Ann Arbor, Michigan, USA. [9]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, USA.

*These author contributed equally.

Objective: Mucoepidermoid carcinoma (MEC) is the most common salivary gland cancer and is frequently treated by surgical resection. However, treatment options are limited for patients who develop recurrent and/or metastatic disease. In this study, we sought to test the potential viability of EGFR therapy against MEC.

Methods: Effects of anti-EGFR therapy were evaluated against 3 MEC cell lines. Cells treated with varying doses of Erlotinib (EGFR inhibitor) were assayed for changes in cell proliferation, apoptosis, cell cycle, 2D colony formation, 3D sphere formation and cancer stem cell disruption. Additionally, a combinatorial treatment paradigm using EGFRi + HDACi was evaluated. And a novel, recently described dual EGFR/HDAC inhibitor CUDC-101 was tested.

Results: Anti-EGFR monotherapy strongly inhibits MEC cell proliferation (IC_{50} = ~200nM) and causes cell cycle arrest in a dose-dependent fashion. Furthermore, Erlotinib treatment was able to reduce MEC cell 2D colony and 3D tumor sphere capacity in doe depend manner. However, even the maximal doses of Erlotinib tested, 25 uM (~80x IC50 for cell proliferation), failed to induce any apoptosis. Thus, while Erlotinib treatment is potently cytostatic against MEC, it fails to exhibit any cytotoxic potential. Notably, we found that Erlotinib treated cells enter a quiescent non-proliferative state wherein they remain viable and can rapidly resume proliferation upon drug withdrawal. Additionally, we found that a combinatorial EGFR (Erlotinib) + HDAC (SAHA) inhibition can synergistically overcome anti-EGFR resistance exhibited by MEC cells. Lastly, we found that a single small molecule, CUDC-101, a dual EGFR/HDAC inhibitor demonstrates exerts potent cytotoxic towards MEC.

Conclusion: While individual single-agent EGFR or HDAC inhibitors are somewhat effective at blunting MEC cell growth and inducing apoptosis, these approaches suffer from critical setbacks including acquired resistance to long-term therapy and significant off-target cytotoxicity. Given these critical setbacks, dual EGFR/HDAC targeting using low doses of CUDC-101 is an attractive therapeutic option for MEC.

Funding Sources: NIH/NCI Howard Temin Pathway to Independence Award in Cancer Research R00-CA157954 (ALA), UNC Cancer Research Funds (ALA), NIH/NCATS TraCS Translational Team Science Award (ALA)

(13) Molecular Signatures of In-situ to Invasive Breast Cancer Progression: An Integrated Mouse and Human Study

Thennavan A[1,4], Xiaping He[4], Charles M Perou[2,3,4]

[1]Oral and Craniofacial Biomedicine Program, School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, USA [2]Department of Genetics, University of North Carolina at Chapel Hill, Chapel Hill, USA [3]Department of Pathology & Laboratory Medicine, University of North Carolina at Chapel Hill, Chapel Hill, USA [4]Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, USA

Objective: Ductal Carcinoma in Situ (DCIS) is considered an important precursor stage immediately preceding invasive ductal carcinoma (IDC) of breast. 20-40% of DCIS form IDC however, currently we lack robust molecular signatures to predict progression prone DCIS. Sequencing the progression path of in-situ lesions in a mouse model, and in human samples should help to understand the drivers of transformation.

Methods: We utilized the C3-TAG genetically engineered mouse model that forms DCIS like precursor lesions, and human ER+ and ER- DCIS-IDC pairs for genomic analyses. Through single cell RNA-sequencing, and bulk mRNA-seq, we identified disease stage specific, and cell population specific, signatures at three stages of breast cancer tumor progression in the C3-TAG mouse model.

Results: Through integrated analysis we subset cancer cells in the DCIS and tumor stage and identify genes and gene signatures relevant in the tumor stage like HIF-1-alpha pathway (Fos proto-oncogene, lactate dehydrogenase A); endocrine resistance (cyclin dependent kinase inhibitor 2A, KRAS proto-oncogene, GTPase, heparin binding EGF like growth factor, cyclin D1). We also detect gene changes in the immune, endothelial and fibroblast cells as DCIS transitions to tumor stage. In terms of immune signals, we identify a sharp decline of CD8 T cell genes (CD274, C-C motif chemokine ligand 5, SLAM family member 7) from DCIS to tumor highlighting the immune dysregulation required for the in-situ stage to become invasive. Utilizing gene set enrichment analysis, we show that our C3-TAG DCIS stage tumor cell signature was significantly enriched in the human basal-like DCIS, and not in Luminal A DCIS.

Conclusion: These results highlight that the C3-TAG DCIS may recapitulate the biology of basal-like DCIS and that progression in basal-like maybe different than in Luminal/ER+ cancers. Further interrogation of derived signatures may lead to identification of a clinical marker of progression and/or a therapeutic target of early intervention.

Funding Source: NCI Breast SPORE program (P50-CA58223), Breast Cancer Research Foundation, Susan G. Komen (SAC-160074)

(14) Periodontal Pathogens Reactivate EBV+lymphocytes Facilitating EBV Transfer to Oral Keratinocytes.

Seaman WT, Arnold A, Webster-Cyriaque J

Adams School of Dentistry, University of North Carolina, Chapel Hill, USA

Objective: Epstein-Barr virus (EBV) is a DNA tumor virus important in human oral and gastric cancers. Lytic viral gene expression, results in permissive epithelial infection, virus production and subsequent life-long latent infection in B-lymphocytes. We previously demonstrated correlations between EBV viral load and periodontitis severity, suggesting periodontopathic bacteria contribute to EBV reactivation. This study sought to determine mechanisms underlying bacteria-mediated EBV+B-cell reactivation and subsequent transfer of virus to permissive oral keratinocytes.

Methods: B-cells latently infected with EBV genomes containing GFP and neomycin resistance cassettes were treated with bacterial products (BP) from pathogenic bacteria (*F. nucleatum* [Fn] and *P. gingivalis* [Pg]) or commensals *S. Sanguinus* [Ss]. Pathogen-induced changes in signaling and epigenetic marks were assessed by western blot. EBV lytic gene expression was assessed by RT-qPCR and western blot analysis. Interactions between EBV+ B-cells and oral keratinocytes were determined by fluorescent microscopy.

Results: Pathogen BP increased global expression of activating epigenetic modifications (H3 acetylation), non-canonical NF□B, and viral lytic proteins in EBV+ B-cells by western blot analysis while commensal BP did not. Viral lytic mRNA (immediate-early, early and late) were detected by RT-qPCR. Pathogen BP-treatment enhanced B-cell adherence to oral keratinocytes in culture. GFP+ oral keratinocytes containing EBV were observed after co-culture with Fn BP-treated B-cells.

Conclusions: Pathogen-BP induced NF□B and H3 driven-modifications suggests that periodontal pathogen driven signaling and epigenetic marks are involved in EBV+B-cell reactivation and full lytic gene expression *in vivo*. Further, pathogen-BEP facilitated transfer of EBV from B-cells to epithelial cells. Together these results suggest that periodontal pathogens drive EBV pathogenesis including lytic reactivation, transmission, and potentially virus-associated malignancy.

Funding: NIDCR 1 R56 DE023940-01, NIH/NIAID 1—U01—AI103390—01

Craniofacial, Skeletal and Oral Biology and Disease

(15) Self-Reported Non-Pharmacological Treatments Differ between Clusters of Orofacial Pain Patients

Vivaldi D[1, 2], Alonso A[2], Smith BS[2], Maixner W[2]

[1]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill [2]Center for Translational Pain Medicine, DUKE University

Objectives The study aim is to investigate the differences in self-reported non-pharmacological treatments between three clusters of patients suffering from orofacial pain: the adaptive, the pain sensitive and the global symptoms clusters. We hypothesize that patients belonging to the global-symptoms cluster will report a greater number of non-pharmacological treatments compared to the other clusters.

Methods: This is a cross-sectional study of patients suffering from orofacial-pain who sought treatment at non-opioid prescribing chronic pain clinic between 03/01/2017 and 10/03/2019. Patients at this clinic are systematically assigned to one of the 3 clusters (adaptive, pain sensitive, global-symptoms), and they complete a series of surveys that include their experience regarding 25 non-pharmacological treatments. Data on the modality and the number of non-pharmacological treatments (such as physical-therapy, acupuncture) were collected and analyzed to describe the differences between the clusters. Parametric and non-parametric tests were used for data analysis. Statistical significance was set at 0.05 and power at 0.80. Patients gave their written consent to participate in the study. IRB number Pro00077946.

Results: A total of 310 patients were included in the study. The adaptive cluster accounted for 44% of patients, followed by the pain sensitive, 31%, and global symptom, 25%, clusters ($P<0.001$). Non-pharmacological treatments were reported by 248 patients (80%). The global-symptom cluster had the highest number of participants endorsing non-pharmacological treatments, followed by the pain sensitive and adaptive cluster (92%, 82% and 71% respectively; $P<0.001$). The median numbers of non-pharmacological treatment reported by the adaptive, pain sensitive and global-symptoms clusters were: 2(IQR-5), 2(IQR-5), and 5(IQR-5), $P<0.001$, respectively. Ice/heat (58%), oral-appliance (53%),

massage (43%) and physical-therapy (40%) were the most common non-pharmacological treatments reported.

Conclusions: In patients suffering from orofacial-pain, non-pharmacological treatments are commonly reported, however their endorsement is different between the adaptive, pain sensitive and global-symptoms cluster. Non-pharmacological treatments are more prevalent in the global symptoms cluster.

Funding Source: Dr. Vivaldi was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number T32GM086330. The content is solely the responsibility of the authors and does not necessarily represent the official views of National Institutes of Health.

(16) Caspase-1-mediated Periodontal Bone Destruction is Sex-dependent

Girnary MS[1], Swanson KV[2], Vias NP[1], Moss K[3], Beck J[1], Styner M[4], Byrd KM[3], Wang L[5], Ting JP[6,7,8,9], Webster-Cyriaque J[3], Marchesan JT[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Medicine, Infectious Diseases, University of North Carolina at Chapel Hill, [3]Divison of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [4]Department of Medicine, Division of Endocrinology and Metabolism, University of North Carolina at Chapel Hill, [5]Oral and Craniofacial Biomedicine Program, Adams School of Dentistry, University of North Carolina at Chapel Hill, [6]Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, [7]Department of Genetics, University of North Carolina at Chapel Hill, [8]Institute for Inflammatory Diseases, University of North Carolina at Chapel Hill, [9]Center for Translational Immunology, University of North Carolina at Chapel Hill

Objectives: Men have a higher prevalence of periodontal disease than women. Mechanisms underlying this sexual dimorphism are unclear. The main aim of the study was to determine the impact of sex in the periodontal inflammatory response.

Methods: Gingival crevicular fluid (GCF)-IL-1β levels from 6,182 individuals were evaluated by ELISA and compared for sex-related differences. Experimental periodontitis progression in male and female mice was evaluated in a time-dependent manner (0, 3, and 9-days). Gingival IL-1β expression was measured by quantitative real-time PCR (qRT-PCR) and bone levels by micro-computed-tomography (µCT). Peritoneal macrophages plated at $2.5x10^5$ cells/well were stimulated with AIM2 (poly:dA/dT) and NLRP3 (nigericin) agonists. Supernatants were analyzed for IL-1β levels by ELISA. To evaluate the impact of IL-1β in experimental periodontitis, we administered caspase-1 inhibitor VX-765 (which cleaves IL-1β into its active form) to female/male/ovariectomized female mice. Alveolar bone loss was analyzed by µCT.

Results: Men had significantly higher GCF-IL-1β levels than women (155.07±5.63 vs. 134.3±3.4 [mean ± SE] ng/mL). In the experimental periodontitis model, male mice exhibited a 10-fold increase in gingival-IL-1β expression compared to 3-fold in females ($p \leq 0.007$) at 3-days post-ligature. Inflammasome activation was evaluated in peritoneal macrophages, and cells derived from male mice had ~5 times higher IL-1β levels when stimulated with AIM2 and NLRP3 inflammasome agonists. When treated with a caspase-1 inhibitor (VX-765) upon induction of periodontitis, a ~50% decrease in alveolar bone-loss was observed in male mice at 9-days ($p=0.03$). No effect in bone-loss was observed for female mice (unmodified and ovariectomized) that received the drug, suggesting that the sexual differences are unlikely to be mediated by the presence of female hormones.

Conclusion: The understanding that males have a more robust and dominant IL-1β response provides novel information on the potential for caspase inhibition as a treatment for periodontal diseases.

Funding: This study was funded by the National Institutes of Health KL2TR002490 (K.V.S), K08DE026537 (K.M.B.), K01DE027087 (J.T.M.), the American Association for Dental Research Anne D. Haffajee Award (J.T.M), and the DDS Short-Term Research Fellowship Grover C. Hunter Award (M.S.G.).

(17) Analysis of Osteoclasts in a Periodontitis Model

Girnary MS[1], O'Neal MR[2], Martin KT[2], Vias NP[1], Bush M[1], Marchesan JT[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA, [2] Dental student, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Objective: Periodontal disease is an exaggerated inflammatory response of the tooth supporting tissues that has the host response as a major contributor for disease development and progression. Men have a well-known higher degree of periodontal disease susceptibility, progression and severity than women. However, sex-based immunological differences are significantly understudied in the field of periodontology. The objective of this study is to characterize the impact of caspase-1 inhibition on osteoclast numbers using the experimental periodontitis ligature model.

Methods: Periodontitis was induced in male and female mice (n=8/group) using the simplified-ligature model and evaluated at 9-days post-ligature placement. Mice received daily oral administration of vehicle (DMSO) or VX-765 (100mg/kg) for 9 days beginning one day prior to ligature placement. Maxilla was collected and processed for histological analysis of osteoclast numbers by cathepsin K immunostaining. Cathepsin K is responsible for the degradation of type I collagen in osteoclast-mediated bone resorption. Regions of interest were defined as region 1) number of cells in the alveolar bone region adjacent to the ligature and region 2) number of cells/slide. Data was evaluated by Student's t-test.

Results: No statistically significant differences were observed in the number of cathepsin K positive cells between vehicle and treated female mice in region 1 (vehicle vs. VX-765, 2.0±2.16 vs. 1.4±2.0 [mean ± SD], p=0.3) region 2 (vehicle vs. VX-765, 7.3±10.2 vs. 4.6±3.1 [mean ± SD], p=0.3). Similar were obtained comparing male mice for region 1 (vehicle vs. VX-765, 5.1±5.1 vs. 2.1±1.8 [mean ± SD], p=0.1) and region 2 (vehicle vs. VX-765, 7±5.4 vs. 5±4.7 [mean ± SD], p=0.2). When comparing females vs. males the number of cathepsin K-positive cells was also not statistically significant for region 1(vehicle, p=0.3; VX-765, p=0.5) or region 2 (vehicle, p=1.0; VX-765, p=0.9).

Conclusion: Our preliminary data shows that the number of osteoclasts were not distinct between male and female mice treated with a caspase-1 inhibitor. This suggests that the differences in bone resorption observed between males and females may not be based on the presence of cells. Future studies will further characterize functional differences between males and females under the experimental periodontitis model.

Funding: This study was funded by the National Institutes of Health K01DE027087 (J.T.M.), the American Association for Dental Research Anne D. Haffajee Award (J.T.M)

(18) Incidence of Mid-treatment Posterior Open Bite Developed in Deep-bite Patients Treated with Clear Aligner Therapy

Risinger RC[1], Allen RK[2], Jackson TH[3]

[1,2]DDS Candidate, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Posterior open-bite (POB) is a commonly-reported undesirable side-effect of tooth movement with clear aligners. The objectives of this study were 1) determine the

frequency of POB introduced in non-growing deep-bite patients during clear aligner therapy, and 2) investigate differences in frequency of POB introduced between deep-bite patients with and without anterior bite ramps.

Methods: Patient records were sourced from UNC's Graduate Orthodontics Clinic. Non-growing patients with a pre-treatment deep-bite (≥4mm) were included and organized into two groups. Group A: deep-bite patients treated with clear aligners without anterior bite ramps and Group B: deep-bite patients treated with clear aligners with anterior bite ramps. Using virtual models, the number of posterior teeth (premolars & molars) in contact before treatment was recorded for each patient. Contact was defined as ≥ 1 contact point per tooth. The number of posterior teeth in contact at the first refinement scan was then recorded. Frequency of POB was calculated as pre-treatment contacts minus mid-treatment contacts and compared across groups.

Results: 69 deep-bite patients were reviewed (average overbite of 4.5mm): 49 presented with a loss in posterior contacts, demonstrating a 57.97% POB creation rate. The overall average change was a loss of 1.22 posterior contacts. The median change was a loss of 1 posterior contact with an IQR of (-3.25, 0). Group A (5 patients) showed a loss of posterior contacts at 40%, and the average change was a loss of 0.8 posterior contacts. Group B (64 patients) showed a loss of posterior contacts at 59.38%, and the average change was a loss of 1.25 posterior contacts.

Conclusion: 57.97% of the patients lost one-or-more contacts, demonstrating a significant frequency of posterior open-bite introduced after the first round of clear aligner therapy. Further data collection is needed to explore the relationship between Groups A and B.

(19) Categorizing Cl III Subtypes, Treatment Modes, and Treatment Outcomes

Pegah Khosravi-Kamrani[1], Christopher A Wiesen[2], Sylvia A. Frazier-Bowers[1]

[1]Divison of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Howard W Odum Institute for Research in Social Science, Chapel Hill, North Carolina

Objectives: The conundrum of determining when to treat a Class III patient is significant, creating a burden on the patient and a challenge for the orthodontist. In this study, we employed a novel statistical prediction model for Cl III patients (SPM3) derived from our previous cephalometric data on 5 predominant subtypes of Cl III malocclusion to test the hypothesis that there is an association between Cl III subtypes and treatment modality by assessing if the need for (i.e. exposure risk) of orthognathic surgery correlates with a specific subtype of Cl III. A secondary objective of this study was to investigate the relationships among Cl III subtype, treatment modality, and treatment outcome to establish, on the basis of subtype, which treatment modalities are predictive for successful treatment.

Methods: We assessed a random cohort of 1004 patients within our imaging database (ages 7-25 with ANB ≤ 0). Subjects with available pre and post-treatment records were included based on the following: overjet ≤ 0 mm, concave profile, and no sign of congenital abnormality or trauma. The cohort underwent orthognathic surgery or orthodontics alone. Pretreatment lateral cephalometric records were digitized for anteroposterior and vertical structures, and measurements were applied to a statistical prediction model (SPM3) to assign a Cl III subtype as {1}. {2,3}, or {4,5}. Treatment outcome (success or failure) was determined by facial profile, an overjet and overbite of ≥ 1mm, and absence of posterior crossbite. Fisher's Exact Test and logistic regression analysis was used to identify associations among subtype, modality, and outcome.

Results: We found a statistically significant association exists between subtype and treatment modality. Subtype 1 had a higher proportion (30%) of surgical treatment while subtype 2,3 and subtype 4,5 had a higher proportion of orthodontic treatment (79% and 88% respectively). Subtype 2,3 had a higher proportion of success (80%) while subtype 1 and

subtype 4,5 had a higher proportion of failure (36% and 40% respectively). This effect was seen across all treatment modalities. Studies with a larger cohort will interrogate if an association exists between treatment outcome as a function of subtype.

Conclusion: The SMP3 revealed subtype 1 (mandibular prognathic) showed a likelihood for orthognathic surgery. This machine learning approach also revealed subtype 2,3 as being substantially a lower failure subtype across all modalities. Further refinement of the model may yield a prediction model for all 5 Class III subtypes and their optimal treatment modality.

Funding: This project was supported by the Grover C. Research Fund.

(20) Sex impact of Caspase-1 Inhibition on Inflammatory Cell Migration in Experimental Periodontitis

Martin KT[1], Girnary MS[1], O'Neal MR[1], Vias NP[2], Bush M[3], Marchesan JT[3]

[1]Dental Student, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [2]Undergraduate Student, University of North Carolina at Chapel Hill, Chapel Hill, NC [3]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC

Objective: Periodontitis results from a complex interaction between dental biofilm microorganisms and the host inflammatory response. Sex differences may affect the bacterial host immune response and alter the disease clinical presentation. Sexual dimorphism is still significantly understudied in the periodontal field. The objective of our study was to evaluate the number of inflammatory cells in male and female mice that were given a caspase-1 inhibitor using the experimental periodontitis ligature model.

Methods: Periodontitis was induced in male and female mice (n=8/group) using the simplified-ligature model and evaluated at 9-days post-ligature placement. Mice received daily oral administration of vehicle (DMSO) or VX-765 (100mg/kg) for 9 days beginning one day prior to ligature placement. Maxilla was collected and processed for histological analysis of gingival neutrophil/macrophage numbers by myeloperoxidase (MPO) immunostaining (positive and negative cells, connective tissue and epithelial layer). The region of interest was defined coronally by the keratin layer and apically by the alveolar bone crest. In the mesial-distal direction the region of interest was defined by the space between the cemento-enamel junction of M1 and M2. Data was evaluated by Student's t-test.

Results: Female mice treated with caspase-1 inhibitor showed significantly higher numbers of MPO+ cells in the connective tissue layer (vehicle vs. VX-765, 31.7± 14.1 cells vs. 50.2± 21.1 cells [mean ± SD], p=0.03). Contrary, male mice treated with VX-765 had higher numbers of MPO+ cells in the epithelial layer of the gingival tissues under experimental periodontitis (vehicle vs. VX-765, 28.8± 16.3 vs. 49.09± 30.6 [mean ± SD], p=0.03).

Conclusion: Our analysis shows that the sex of the mouse distinctively affected the distribution of innate inflammatory cells using the experimental periodontitis model. Future studies will further investigate if differences in the migration and chemotaxis of inflammatory cells between sex may affect periodontal disease pathogenesis.

Funding: This study was funded by the National Institutes of Health K01DE027087 (J.T.M.), the American Association for Dental Research Anne D. Haffajee Award (J.T.M) and the Grover C. Hunter Research Fellowship (K.T.M.).

(21) Mandibular Alveolar Bone Remodeling Following Maximum Incisor Retraction

Philips SV[1], Chung CJ[2], Paniagua B[3], Jackson T[4], Nguyen T[4]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Orthodontics, Gangnam Severance Hospital, Institute of Craniofacial Deformity, College of Dentistry, Yonsei University, Seoul, Korea, [3]Department of Psychiatry, University of North Carolina at Chapel Hill, [4]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: The objective of this study is to evaluate changes in mandibular alveolar bone width following maximum incisor retraction.

Methods: Thirty-two consecutive patients with bimaxillary dentoalveolar protrusion treated with premolar extractions and maximum incisor retraction using skeletal anchorage were selected. Pre-treatment (T1) and post-treatment (T2) Cone Beam Computed Tomography (CBCT) volumes were registered using voxel-based mandible regional superimpositions. 3D models of the registered mandibles were built and T1 and T2 alveolar width were measured at the 1) inter-radicular space between the lower central incisors and the 2) mid-root of the mandibular right central incisor. ANOVA analysis was used to determine difference between T1 and T2 alveolar width.

Results: The mean lower incisor retraction was 6.12mm +/- 1.25. At the crestal level, the inter-radicular alveolus showed an average decrease of 1.02mm +/- 0.44 (20% reduction) while the mid-root alveolus showed an average decrease of 0.48mm +/- 0.39 (8% reduction) after incisor retraction. There was a statistically significant difference (P=0.05) between the bone change at the inter-radicular regions versus the mid-root regions.

Conclusion: There was a decrease in buccal/lingual width of the alveolus following maximum incisor retraction. At the crestal level, the reduction of alveolar width was more significant in the inter-radicular region.

Funding: Grover C. Hunter Research Fund, Adams School of Dentistry, University of North Carolina at Chapel Hill

(22) MicroCT as Reference Standard for ICDAS and QLF-D

Hoxie AM[1], Vasconcellos AB[2], Jain S[3], Zandona AF[3], Ribeiro AA[1]

[1]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel, [3]Department of Comprehensive Care, Tufts University School of Dental Medicine

Objectives: To evaluate the reliability and validity of the International Caries Detection and Assessment System (ICDAS) visuo-tactile criteria and quantitative light-induced fluorescence digital (QLF-D; Inspektor Research Systems, The Netherlands) technology for activity and depth, using micro-computed tomography (microCT) as reference standard.

Methods: Extracted permanent human teeth with sound surfaces and non-cavitated carious lesions on root surfaces (Root Caries ICDAS 1) were selected (n=60). Three calibrated examiners evaluated surfaces using ICDAS to distinguish sound, active, or inactive lesions, repeating the exam one week later. Examiners ran the plaque patch function on QLF-D images using QA2 image analysis software (Inspektor Research Systems), in addition to white spot analysis. Eleven teeth were randomly selected and scanned using high-energy microCT (Scanco µCT 40, Scanco Medical, Switzerland) as gold standard for lesion depth. Mineral density changes were observed at the greatest lesion depth for analysis (Scanco µCT software v6.1). The ICDAS/ICCMS radiographic scoring system was used to classify microCT images.

Results: The root surfaces were classified as sound (n=4) or RA3 carious (radiolucency limited to the outer 1/3 of dentin; n=7) by microCT analysis. ICDAS exams amongst all three examiners resulted in sensitivity and specificity of 1.00 in identifying lesion presence and reliability of 0.59±0.05 for activity assessment. QLF-D ΔRMax values ranged in sensitivity from 0.86-1.00 amongst examiners and reliability of 0.60±0.12 for activity assessment, while both 95ΔQ and 95ΔF data resulted in sensitivity and specificity of 1.00 for lesion presence. Mineral density averages among sound root surfaces varied between 1077-1255 mgHa/cm^3 (mean=1175) and RA3 carious between 390-951 mgHa/cm^3 (mean=688).

Conclusion: Preliminary data from this ongoing study suggest that both QLF-D and ICDAS examinations are reliable means for identifying carious lesions and had moderate agreement to detect activity in root surfaces. Continued efforts with the remaining surfaces will optimize density thresholds for activity and arrestment of root surface lesions.

Funding: 2019-2020 DDS Short Term Research Fellowship, UNC Adams School of Dentistry

(23) Association of Apical Periodontitis with HbA1c Levels in Hospital Patients

Nathan Yip[1], Chuwen Liu[2], Dr. Di Wu[2], Dr. Ashraf Fouad[3]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2] Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Previous studies have shown an association between type 2 diabetes mellitus (T2DM) and the prevalence of endodontic infections and the outcomes of their treatment. However, few studies have studied the association between the level of glycemic control (HbA1c) and apical periodontitis (AP). The purpose of this study was to determine if HbA1c levels were associated with AP in a large data set available from a hospital network database.

Methods: Carolina Data Warehouse for Health (CDW-H) is a central data repository containing clinical, research, and administrative data sourced from UNC Health Care, including both Epic and Legacy hospital systems. An initial search of this database yielded a total of 5,995,011 patients, of whom 7,749 were diagnosed with AP (ICD-10 codes K04.4-K04.8) between October 1st, 2015 and September 30th, 2018. These codes include the following diagnoses, acute apical periodontitis of pulpal origin, chronic apical periodontitis, periapical abscess with or without sinus, or radicular cyst. Patient demographics, T2DM, and HbA1c data were collected from their most recent visit in which these data were entered. A separate control group of those without AP (7,749 patients) were sampled from the remaining pool of patients in CDW-H and matched exactly to the age, race/ethnicity, and sex of each patient in the initial group. A two sample paired t-test was conducted to test the association between levels of HbA1c with AP on a continuous scale. Fisher's exact and Chi square tests was used to analyze the association between levels of HbA1c with AP on a categorical level (well-controlled (<6.5), moderately-controlled (6.5-8), poorly-controlled (>8) diabetes).

Results: Based on the t-test, higher levels of HbA1c were associated with AP with a mean HbA1c of 6.73 in those with AP and 6.03 in those without AP ($p<2.2x10^{-16}$). Categorically, moderately controlled HbA1c (OR=1.46, 95% CI=1.2, 1.9) and poorly controlled HbA1c (OR=3.10, 95% CI=2.3, 4.1) were associated with greater prevalence of AP.

Conclusion: Patients with higher HbA1c levels and less controlled glycaemia levels may have greater odds of having apical periodontitis.

Funding: Grover C. Hunter Research Fund & Division of Comprehensive Oral Health

(24) Neurosensory Disturbance of the Lingual Nerve after Bilateral Sagittal Split Osteotomy

Holewa, C[1], Turvey, TA[1], White, R[1], Phillips, C[2]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Advanced Dental Education & Graduate Studies, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objective: A bilateral sagittal split osteotomy (BSSO) is performed to treat mandibular deformity. Although altered sensation directly related to inferior alveolar nerve (IAN) injury due to this surgery has been extensively studied, limited research has been done to study lingual nerve neurosensory disturbance. Because mandibular surgery is performed in close proximity to the inferior alveolar neurovascular bundle, a high risk exists of trauma to this nerve. Changes during healing can result in sensory disturbance reflected in the lip and chin. The anatomic position of the lingual nerve is usually outside the surgical field with BSSO. However, direct trauma to the lingual nerve at surgery or inflammation associated with surgery after BSSO can result in tongue numbness, tingling, difficulty detecting temperature, and altered taste.

The goal of this retrospective study is to determine the incidence of lingual neurosensory disturbance and the long-term impact on affected patients' quality of life.

Methods: A survey was recently sent to patients who have had a BSSO from January 2015-December 2017 at the UNC Department of Oral and Maxillofacial Surgery department. Surveys will be collected and evaluated for the percentage of patients with loss of sensation to the tongue or loss of taste as well as if this has reduced their quality of life.

Results are in process. Preliminarily, results demonstrate the following; 38% of patients reported initial loss of sensation to the tongue immediately after surgery with 35% of those patients having prolonged loss of sensation. Some patients with loss of sensation did experience difficulty with speech and tongue biting. Importantly, 24% of patients who responded that they had any loss of sensation of the tongue immediately after or continued loss of sensation did report altered taste. All patients who reported altered sensation did report at least some improvement since time of surgery.

Conclusion: The results of this will make it possible to better inform prospective patients of their risks at surgery and the possibility of altering surgical practices to reduce the incidence of lingual nerve sensory deficit.

(25) The Peripheral Blood Leukocytes Epigenetic Profile of Electronic Cigarette Smokers: A Clinical Pilot Study

Fahimipour F[1], Kim S[1], Dunhom AR[1], Tarran R[2], Barros S[1]

[1]Division of Comprehensive Oral Heath, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina [2]Department of Cell Biology & Physiology, Marsico Lung Institute, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

Objectives: Epigenetic alterations can be the consequence of environmental exposures. Cigarette smoking is one of the relevant risk factors for many oral diseases, including periodontal problems and oral cancers. Recently, the growing number of electronic cigarette (e- cigarette) users among adolescents has been under investigation, and the effects of electronic cigarette exposure on epigenetic profiles are still unknown. With this study we proposed to investigate blood samples to compare the epigenetic profile of e- cigarette users with samples from non-smokers

Methods: Twenty-four individuals were evaluated, samples analyzed consisted of blood collected from 12 adolescents, e- cigarette smokers and 12 others who had never smoked.

The included participants had periodontal evaluation and were diagnosed with gingivitis. The epigenetic profile using bisulfite conversion of 1 µg genomic DNA isolated from peripheral blood leukocytes according standardized procedures. Then the methylation analysis was done using the Illumina Infinium Methylation EPIC BeadChip platform and data analyzed through Ingenuity Pathway Analysis (IPA).

Results: The epigenetic profile of peripheral blood samples confirmed methylation alteration more specifically associated with cancer related genes. The methylation analyzes showed that hypomethylation of GRB2 (growth factor receptor-bound protein 2) and hypermethylation of GRK6 (G protein-coupled receptor kinase 6) genes was significantly associated with e-cigarette exposure. Generally, the GRB2 hypomethylation leads to upregulation of the gene, which is essential for cellular proliferation and invasion, two hallmarks of cancer. Additionally, the hypermethylation of GRK6 (G protein-coupled receptor kinase 6) has been associated with hypopharyngeal squamous cell carcinoma.

Conclusion: Our data indicate that e-cigarette associated activation of genes trigger oncogenic pathways signatures. pathways Further assessments is needed to analyze the safety of e-cigarettes and their effects in systemic and oral health.

(26) Unravelling the role of autophagy machinery in osteoclastogenesis

Wong SW[1], Hu XX[2], Ko CC[3], Miguez P[1], Martinez J[4]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Division of Craniofacial and Surgical Care, University of North Carolina at Chapel Hill, [4]Immunity,Inflammation,and Disease Laboratory, National Institute of Environmental Health Sciences, National Institutes of Health

Objectives: Osteoclasts (OCs) are multinucleated bone cells responsible for resorbing mineralized bone, and increased osteoclastogenesis can result in bone resorptive diseases, such as periodontitis. Studies have shown that autophagy, an intracellular degradation pathway, is involved in OC function. However, the role of autophagy machinery in OC differentiation remains elusive. As we observed that autophagy is induced and expression of autophagy proteins is increased in vitro osteoclastogenesis, and therefore we hypothesized that components of the autophagy machinery are required for OC differentiation.

Methods: We used LysM-Cre mice to generate myeloid-restricted autophagy deficient mice (Becn1-cKO, Vps34-cKO, Atg14-cKO, Fip200-cKO, Uvrag-cKO and Atg5-cKO) that delete autophagic components in OC precursors. Femurs and tibiae were collected for micro-CT scanning, H&E and TRAP staining. *In vitro* osteoclastogenesis was performed. Global gene expressions of osteoclasts were profiled by Affymetrix GeneChip arrays. Target protein and gene expressions were assessed by western blotting and qPCR, respectively.

Results: Young (2-month-old) mice lacking Becn1 (Becn1-cKO) exhibit significantly increased bone mass due to defective osteoclastogenesis, compared to littermate controls. Additionally, 12-month-old Becn1-cKO mice show reduced bone resorption, suggesting that ablation of Becn1 protects against age-induced bone loss. In order to determine if Becn1 is required for differentiation of OCs, we next generated OCs from bone marrow of WT and Becn1-cKO mice. Becn1 deficiency resulted in 2-fold reduction of OC number compared to that of WT OCs. Similarly, we found that the absence of Vps34, Atg14, or Fip200, but not Uvrag or Atg5, results in reduced osteoclastogenesis in vitro. Collectively, these data demonstrate that while Fip200 and the PI3KC3 complex (Becn1, Vps34 and Atg14) are required for OC differentiation, Uvrag and the downstream conjugation protein, Atg5, are no. Mechanistically, Becn1-deficient OCs have a decreased activation of the non-canonical NF-kB pathway, but not MAPK, CREB, or canonical NF-kB pathways during the differentiation. Microarray analysis further confirmed an increased expression of non-canonical NF-kB genes and a decreased expression of non-canonical NF-kB inhibitor genes in Becn1

deficient OCs. Finally, treatment of WT OC precursors with Spautin-1, a specific PI3KC3 inhibitor, blocks OC differentiation in a dose-dependent manner.

Conclusions: Taken together, our data reveal that upstream complexes (Fip200 and PI3KC3) in the autophagy pathway are essential for osteoclastogenesis and could represent novel targets for therapeutic interventions of bone resorptive diseases.

Funding: NIH/NIEHS 1ZIAES10328601 and NIH/NIDCR R90DE022527

(27) *Pseudomonas aeruginosa* Promotes the Survival of Strict Anaerobic Pathogens Under Aerobic Growth Conditions

Metzger LA[1], Arnold R[2]

[1]Undergraduate College of Arts and Sciences, University of North Carolina at Chapel Hill, [2]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: The cystic fibrosis (CF) airway is characteristically colonized by a highly virulent, mucoid *Pseudomonas aeruginosa* infection. Recent evidence also supports a role for strict anaerobes such as *Porphyromonas gingivalis* and *Fusobacterium nucleatum* as pathogens in the CF airway. These bacteria lack enzymes such as peroxidases and catalases, so they would not be able to protect themselves from large amounts of hydrogen peroxide that would be encountered in the inflamed airway environment, nor could they survive extended exposure to oxygen. Because of this, it is unclear how they can live in the CF airway. *P. aeruginosa* could provide protection against oxygen in the surrounding air, which may help facilitate anaerobic organism growth in an aerobic environment.

Methods: To test this, we performed a series of broth and agar co-cultures of strains of *P. aeruginosa*, *F. nucleatum*, and *P. gingivalis* in various combinations of growth conditions, including assorted oxygen levels.

Results: We determined that *F. nucleatum* and *P. gingivalis* require the presence of *P. aeruginosa* to grow in an aerobic atmosphere. Both strains of *P. aeruginosa* tested were able to facilitate a significantly greater recovery of anaerobic organisms in broth culture and agar plates after prolonged exposure to oxygen than the anaerobes produced alone.

Conclusion: The protective effects by *P. aeruginosa* on the anaerobic bacteria may be due to a combination of its use of oxygen in a microenvironment and its formation of a physical barrier around the anaerobic bacteria. Further experimentation must be performed to determine the exact protective functions.

Funding: Oral Microbiology Laboratory, Adams School of Dentistry, University of North Carolina at Chapel Hill

(28) Inhibitory Effect of Streptococci on the Growth of Oral Pathogens *F. nucleatum* and *P. gingivalis*

Pendleton M[1], Arnold R[2].

[1]Department of Biology, University of North Carolina at Chapel Hill. [2]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Periapical abscesses are a result of a bacterial infection in the root of the tooth, a common consequence of endodontic root canals. The accepted model of periapical abscess development proposes that initial colonization of the tooth surface by *Streptococcus intermedius* allows the subsequence attachment and growth of the pathogenic organisms *Fusobacterium nucleatum* and *Porphyromonas gingivalis*. Although this model has been proposed based on clinical probes of periapical abscesses, no colonizing relationship between the bacteria has yet been demonstrated.

Methods: Interspecies interactions were observed via liquid and agar co-cultures, lawn growth assays, and proximity growth assays. Liquid and agar co-cultures of *S. intermedius*, *F. nucleatum*, and *P. gingivalis* were grown in an aerobic chamber, and the aerobic tolerance of varying bacterial combinations was measured. Lawn assays were performed with spots of each bacteria laid over a lawn of an individual bacteria, and effects of the spots on lawn growth were observed. Proximity growth assays had individual bacteria spotted adjacent to one another, and diffusible effects on bacterial spot growth were observed.

Results: In the liquid and agar co-cultures provided, the presence of *S. intermedius* did not increase the aerotolerance of *F. nucleatum* or *P. gingivalis*. Similarly, lawn growth assays showed that spots of *S. intermedius* had no discernable effect on the growth of the surrounding lawn. Clinical salivary streptococci isolates showed inhibitive effects on the growth rate of the lawn with a distinct zone of inhibition. The mechanism of inhibition by clinical streptococci isolates was shown to be diffusible through the proximity growth assay, where a spot of isolated salivary streptococci was able to inhibit growth of the closest bacteria.

Conclusion: Our results did not support the accepted model of periapical abscess development and suggest that salivary streptococci play a role in inhibiting the growth of the pathogenic organisms *F. nucleatum* and *P. gingivalis*.

(29) Clinicians Difficulty Predicting Post-Procedure Acute Pain Levels

Oliverson TJ[1], Catlin KA[1], Reside GJ[2], Matthews NS[2], White RP[2], Phillips C[2]

[1]OMS Research Assistant, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Widespread prescribing of opioid analgesics for acute pain has led to addiction and overdose, particularly among opioid naïve young adults.(1,2) Clinicians have attempted to manage acute pain after surgery for centuries. Aided by the availability of immediate-release opioid drugs, hydrocodone, and oxycodone, clinicians responded aggressively to the challenge from JCAHO to better control acute pain, prescribing a high number of opioid doses post-procedure. Clinicians have been “well-meaning”, prescribing analgesic drugs expecting the worst pain outcome rather than reducing pain to a level below 50% of the maximum.(3,4) Opioid analgesics sufficient to manage the worst-case scenario benefit 20% of patients with extreme pain, while providing 80% of patients with drugs not needed. Large numbers of left-over opioid drug doses are misused, contributing to increasing trends of opioid addiction and subsequent deaths from overdose. Clinicians can alleviate the problem by restricting opioid drugs to those expected to have severe pain. In this project, we assessed prescribing patterns of analgesics for acute pain. We hypothesized that clinicians can accurately predict acute pain levels, limiting opioid analgesics to those expected to experience severe pain.

Methods: Data is from a Qualtrics Survey to a random sample of NC general dentists and endodontists with current DEA registration. The survey scenario represented a frequent clinical encounter (i.e., “cracked tooth”). Respondents were asked to indicate the type of analgesics prescribed.

Results: From a convenience sample, NC general dentists (85) and endodontists (20); 10% of general dentists and 20% of endodontists reported prescribing an opioid for the clinical scenario. Also, 92% of general dentists and 90% of endodontists indicated prescribing an NSAID for control of acute pain, with varying scheduling protocols.

Conclusion: We attributed opioid analgesic prescribing as a proxy for expected severe pain. Differences in prescribing practices for the same clinical scenario suggest the difficulty clinicians face predicting post-procedural pain. At present reliably predicting Severe Pain limits establishing professional guidelines for analgesic prescribing practices.

Funding: Departmental Research Funds in the Dental Foundation of North Carolina

(30) Anatomical Variations of Mental Foramen Detected by CBCT. A Case Report

Conner CD, Glavich DM, Martinez Luna AA, Paquette DW, Gillone A

School of Dental Medicine, East Carolina University, Greenville, NC

Objectives: Located near the apex of the second premolar, the mental foramen is an important landmark when administering anesthesia or performing other oral surgical procedures. Cone Beam Computed Tomography (CBCT) is considered the state-of-the-art technology in detecting variations in the mental foramina. Variations in the mental foramen have been described throughout the literature and the most frequent finding is the presence of a double mental foramen at 1.4% - 12.5%. The presence of a triple mental foramen ranges from 0.7% - 1.2%. The case presented describes a triple foramen on the right side and a double mental foramen on the left side of the mandible in a 62-year-old African American male patient.

Conclusion: CBCT is the best method to use in regard to 3D imaging and diagnosing the presence of accessory mental foramina. By using CBCT, dentists and other specialists can determine the anatomic variation of the mental foramen. Knowing this anatomy can be crucial in surgeries such as extractions, orthognathic surgery, periodontal surgery, and dental implants.

(31) Molecular Analysis of Tooth Eruption Disorders

Senties-Ramirez G[2], Radley BD[1], Frazier-Bowers SA[1]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [2]Private Orthodontic Practice, San Antonio, Texas

Introduction: Dental ankylosis is a histological definition for a condition that is often clinically indistinguishable from other eruption disorders. Confusion between ankylosis and Primary Failure of Eruption (PFE) can result in an inaccurate diagnosis, inappropriate orthodontic management and frustration for the clinician and patient. In this study we test the hypothesis that eruption disorders are clinically distinguishable with a distinct molecular and genetic expression profile. We posit that a specific genetic and molecular profile exists in PFE as compared to those with an unspecified eruption disorder.

Methods: To test our hypothesis, we used previously diagnosed patients with completed mutational analysis of *PTH1R* on and/or suspected ankylosis to performed gene expression studies of PDL tissue from affected extracted teeth. PDL tissue collected from extracted teeth was subject to RNA extraction followed by RT-PCR. Gene expression studies of *PTH1R, RANKL, BMP2, BMP-4*, and *BMP6* for ankylosed, control, and PFE teeth were completed.

Results: RT-PCR revealed differences in the expression of *BMP4*, *BMP6,* and *PTH1R* between control, PFE and ankylosed cell cultures; *BMP4* expression levels were absent in the RNA extracted from PFE-affected teeth.

Conclusion: Our data suggest *that BMP4* may be a downstream effector in a pathway affected by *PTH1R* mutations. Ongoing studies will interrogate the association between PFE and ankylosis in our sample.

Funding: The Dora Lee and John C. Brauer Dental Research Fellowship.

(32) An Automated Machine Learning Classifier for Early Childhood Caries Prediction

Karhade DS[1], Ginnis J[1], Simancas-Pallares M[1], Shrestha P[1,2], Divaris K[1,2]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objective: Early childhood caries is a persistent clinical and public health problem. Current risk assessment tools may be useful for the identification of modifiable risk factors and patient education, but are weak predictors of ECC incidence. In this study we aimed to develop and evaluate a machine learning algorithm for children's classification according to ECC status.

Methods: We used existing clinical, demographic, behavioral and parent-reported oral health status information for a community-based sample of 6,404 3-5 year-old (mean age=53 months) children participating in ZOE 2.0, an epidemiologic study of early childhood oral health in North Carolina. ECC was defined at the ICDAS>2 threshold. Ten machine learning algorithms containing different sets of predictors were evaluated in terms of ECC classification accuracy [i.e., area under the ROC curve (AUC), sensitivity (Se), positive predictive value (PPV)] using an AutoML Tables deployment on Google Cloud.

Results: A parsimonious model including only two terms (i.e., children's age and parent-reported child oral health status: excellent/very good/good/fair/poor) had the highest AUC (0.74), Se=0.67 and PPV=0.64. In contrast, a comprehensive model with 12 terms covering demographics (including race/ethnicity and parental education), oral health behaviors, fluoride exposure and dental home, had AUC=0.66, Se=0.54, PPV=0.61.

Conclusions: Machine learning offers an efficient means for constructing ECC classifiers with different sets of context- and application-specific predictors. We found that parsimonious, single-item self-reports are valuable in terms of ECC screening. We expect that the currently modest predictive classifier performance will improve with the inclusion of biological (i.e., human genome and supragingival microbiome) information.

Funding: NIH/NIDCR U01-DE025046

(33) β-glucuronidase from *Tannerella forsythia* – An Enzyme Associated with Periodontitis

Lietzan AD[1], Walton WG[2], Redinbo MR[2,3,4]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill; [2]Department of Chemistry, University of North Carolina at Chapel Hill; [3]Department of Biochemistry and Biophysics, University of North Carolina at Chapel Hill; [4]Department of Microbiology and Immunology, University of North Carolina at Chapel Hill

Objectives: Bacterial species associated with periodontitis produce enzymes involved with degradation of the periodontal extracellular matrix. β-glucuronidase (GUS; EC 3.2.1.31), a host-derived enzyme found in the lysosome, is essential for extracellular maintenance and homeostasis. Previous investigations suggest that neutrophils are responsible for an increase in GUS activity during active periodontal inflammation and destruction. This study describes a novel GUS enzyme from *T. forsythia*, a bacterium associated with periodontitis.

Methods: The putative GUS enzyme from *T. forsythia* was subcloned and recombinantly expressed and purified from *E. coli*. To confirm the identity of the enzyme, steady state kinetics and macromolecular X-ray crystallography were utilized.

Results: Steady state kinetic analyses confirms that the enzyme contains GUS activity and that this activity is optimal in pH conditions associated with periodontal inflammation. Furthermore, we determined the X-ray crystal structure of the enzyme to 2.3 Å resolution. While the core fold (TIM barrel) and active site architecture closely resemble that from

human GUS, the oligomeric state, assembly interfaces, and surrounding domains share no similarity. Surprisingly, a domain that closely resembles a carbohydrate-binding domain lies outside of the active site. This superficial domain may be involved with binding and orienting complex polysaccharides into the active site for catalysis.

Conclusion: These data demonstrate that *T. forsythia* is capable of producing an enzyme with GUS activity. It is likely that this enzymatic activity contributes to the degradation of the periodontal extracellular matrix and pathogenesis of periodontitis. Structural differences observed between GUS enzymes may lead to novel therapeutics for the treatment of periodontitis.

(34) Reactive Oxygen Species Regulate Fibronecin Fragment-Induced MAPK Signaling Through NADPH Oxidase 2 and Integrin Endocytosis

Miao MZ[1,2], Collins JA[1,3], Bahson EM[4,5], Chubinskaya S[6], Loeser RF[1]

[1]Thurston Arthritis Research Center, Division of Rheumatology, Allergy, and Immunology, School of Medicine, University of North Carolina at Chapel Hill [2]Curriculum in Oral and Craniofacial Biomedicine, Adams School of Dentistry, University of North Carolina at Chapel Hill [3]Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Pittsburg [4]Department of Surgery, Division of Vascular Surgery, University of North Carolina at Chapel Hill [5]Center for Nanotechnology in Drug Delivery, University of North Carolina at Chapel Hill [6]Department of Pediatrics, Rush Medical College

Objectives: Osteoarthritis is characterized by cartilage extracellular matrix (ECM) degradation, resulting in the production of ECM protein fragments. One of these, fibronectin fragments (FN-f), found in OA cartilage and synovial fluid, promotes further cartilage matrix destruction through activating α5β1 integrin and increasing matrix metalloproteinase (MMP) generation. The purpose of this study was to investigate the role of NADPH oxidase (Nox) as a reactive oxygen species (ROS) generator in chondrocytes and to study the localization of Nox-induced ROS following α5β1 integrin endocytosis.

Methods: Isolated human articular chondrocytes were treated with recombinant FN-f (FN7-10) that contains an α5β1 integrin RGD binding site with or without pretreatments, including pan Nox inhibitors VAS2870 and APX-115, Nox2-specific inhibitor gp91ds-tat, dual Nox1/4 inhibitor GKT137831, and dynamin inhibitor Dynasore. To analyze integrin endocytosis, chondrocytes underwent nucleofection to express different constructs, including α5 integrin-GFP, α5 integrin-mCherry, Rab5CA-mCherry, and Rab7CA-GFP. Alexa Fluor 568 conjugated transferrin followed by DiO plasma membrane labeling was also used to study chondrocyte endocytosis.

Results: Nox2 and Nox4 were identified as the two major Nox isoforms expressed in human chondrocytes. VAS2870, APX-115, and gp91ds-tat abrogated FN-f-induced signaling and MMP-13 generation, whereas GKT 137831 exhibited no effect, indicating that Nox2 was necessary. The α5β1 integrin was endocytosed in response to FN-f in a time-dependent pattern. Following Dynasore pretreatment, a significant reduction in transferrin endocytosis was observed as well as a decrease in FN-f induced MAP kinase activation and MMP-13 generation.

Conclusion: FN-f induced ROS in chondrocytes are generated through Nox2 via integrin endocytosis. To further test this hypothesis, we are determining if Nox2 and the α5β1 integrin are co-localized in endosomes in response to FN-f and if this is a specific site for the activation of MAP kinases. Elucidating this mechanism will lead to the discovery of new therapeutic targets to slow down the development of osteoarthritis.

Funding: This study is supported by National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) R37 AR049003

(35) The Minipig Implant Intra-oral Model: Clinical and Radiographic Characteristics

Musskopf ML[1,2], Finger Stadler A[2], de Sousa Rabelo M[3], Nahas de Castro Pinto R[4], Demoner Ramos U[5], Fiorini T[6], Lienemann P[7], Hoffmann W[7], Susin C[2].

[1]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Private Practice, Sao Paulo, Brazil, [4]SENAC, Sao Paulo, Brazil, [5]Department of Maxillofacial Surgery and Periodontics, USP, Ribeirao Preto, Brazil, [6]Department of Conservative Dentistry – Periodontology, UFRGS, Porto Alegre, Brazil, [7]Nobel Biocare, Klote, Switzerland

Objectives: To describe clinical and radiographic characteristics of the minipig implant intra-oral model (MIIOM).

Methods: Nine Yucatan minipigs, 16-18 months old, approximately 60kg were included. Third and fourth premolars and first molars were extracted, and tissues were allowed to heal for 12 weeks. Hemimandibles were harvested in block and fixated in NBF. A digital caliper was used to measure ridge length from mesial of the second molar to the distal of the second pre-molar. Microcomputed tomography was performed using the following settings for image acquisition: tube potential 90Kv, 111µA, 39ms exposure time, alumina filter 1mm, pixel size 34.5µm. Volume reconstruction was done using the following settings: beam-hardening 20%, no ring artifact correction or smoothing needed. Image segmentation was done using a threshold from 85 to 255. A cylindric volume of interest (VOI) with a diameter of 4mm and length of 10mm was selected and loaded 8mm apart in four separate sites. Generalized estimating equations were used to compare among sites while taking into consideration the clustering of observations within animals (9 minipigs and 18 hemimandibles).

Results: The ridge length was on average 40.2±2.3mm, ranging from 35.4 to 43.6mm. The ridge width at the bone crest level gradually decreased from posterior (6.5mm) to anterior (4.5mm). Similar trend was observed 6 and 10mm below the bone crest. Bone density increased from posterior (43%) to anterior (61%). Trabecular thickness and trabecular number also increased from posterior to anterior, whereas trabecular separation decreased towards anterior. All sites were compatible with the placement of a regular size dental implant; the apical portion of the device in close proximity to the alveolar canal.

Conclusion: MIIOM allows for the evaluation of dental devices as intended for human clinical use. The variability observed in the ridge morphology and bone quality mimics different clinical scenarios observed in humans.

Funding: Nobel Biocare.

(36) Comparison of Open Bite Closure Outcomes with Clear Aligner vs. Skeletal Anchorage Treatment

Hamilton PD[1], Ko CC[2], Scheffler NR[1], Gierie WV[1], Lin FC[3]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill. [2]Division of Orthodontics, College of Dentistry, The Ohio State University. [3]Department of Biostatistics, Gillings School of Public Health, University of North Carolina at Chapel Hill.

Objectives: Mechanics of open bite closure with clear aligners are not well known. This aim of this retrospective study was to assess vertical skeletal and dental changes during open bite closure of patients treated with Invisalign as well as patients treated with skeletal anchorage.

Methods: Initial and final cephalometric radiographs were digitized for 92 consecutive patients with anterior open bites from 3 practices. 12 measurements assessing vertical skeletal and dental relationships were calculated. Patients were divided by clear aligner and skeletal anchorage treatment. Clear aligner patients were further divided by programmed movement: incisor extrusion, molar intrusion, or combination; and by the use of occlusal bite blocks.

Results: One-way ANOVA statistics for clear aligner groups demonstrated no statistically significant difference between programmed movement or presence of bite blocks. The clear aligner group had significant incisor extrusion (U1-PP: 1.18±1.25mm; L1-MP: 0.77±0.91mm) and minor molar extrusion (U6-PP: 0.14±0.85mm; L6-MP: 0.18±0.84mm). Clear aligner treatment was then compared to skeletal anchorage treatment. One-way ANOVA statistics demonstrated significant differences in LFH, U6-PP, Occl plane to SN, and Occl plane to FH ($P<0.05$). Average overbite treated with skeletal anchorage was initially larger (-2.67 vs. -2.15mm) but the sum of incisor extrusion was less with skeletal anchorage treatment (1.38 vs. 1.91mm).

Conclusions: These results demonstrate that clear aligner open bite closure is effective primarily by way of anterior extrusion regardless of appliance setup or design. This also demonstrates that open bite closure with skeletal anchorage preserves the vertical position of the incisors while intruding maxillary molars and affecting LFH and the occlusal plane more predictably than open bite closure with clear aligners.

(37) 3D morphometric quantification of maxillae and palatal defects for patients with unilateral cleft lip and palate via image auto-segmentation

Pastewait MF[1], Wang X[2,3], Tejera B[4], Wu TH[4], Lee YT[4], Lin FC[5], Wang L[6], Shen D[6], Li S[2], Ko CC[1]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina, Chapel Hill, NC, [2]Department of Orthodontics, Beijing Stomatological Hospital, Capital Medical University, Dongcheng District, Beijing, P. R. China, [3]Department of Stomatology, Beijing Tian Tan Hospital, Capital Medical University, Fengtai District, Beijing, P. R. China, [4]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina, Chapel Hill, NC, [5]Department of Biostatistics, University of North Carolina, Chapel Hill, NC, [6]Department of Radiology and Biomedical Research Imaging Center, University of North Carolina, NC

Objectives: Accurate quantification of the complex 3D cleft defect structure is key for optimal treatment planning and patient outcomes. Furthermore, very little is known about the morphometric differences between the affected versus the un-affected side of maxillary halves. The aim of this study is to characterize 3D morphometry of the maxilla and the cleft defect in non-syndromic patients with unilateral cleft lip and palate.

Methods: To test the hypothesis that the defect size is positively correlated with the affected maxilla half, CBCT images were acquired from 60 patients presenting with unilateral cleft lip and palate. The advanced machine learning program LINKS was used to segment the maxilla and defect. Height, width, and length of the defect and the maxilla were measured from the segmented images. To fully characterize the defect, the distribution probability was mapped from superimposed 3D models, paired *t* tests were performed for statistical analysis, and a multiple linear regression was completed.

Results: The defect side demonstrated a significant decrease in maxillary length, anterior width, and volume with mean measurements of 34.31±2.56mm, 17.83±2.06mm, and $21.26\pm3.33\times10^3 mm^3$, respectively, and an increased maxillary anterior height with a mean of 25.91±4.12mm as compared to the non-defect side. Defect superimposition displayed a concentrated distribution near the alveolar bone region and anterior maxillary structures appeared to contribute to defect variability.

Conclusion: Complete 3D defect models were obtained, with structural parameters defined and quantified, to achieve an enhanced understanding of non-syndromic unilateral cleft lip and palate with potential for widespread future clinical applications.

Funding: NIH/NIDCR R01DE022816

Education

(38) Debunk the Junk: A Student-Driven Interprofessional Event

Klein B[1], Giwa J[1], Wolcott M[1,2], Beck Dallaghan G[3], Zomorodi M[4], Brame J[1], Ciarrocca K[1]

[1] University of North Carolina at Chapel Hill, Adams School of Dentistry; [2] UNC-CH, Eshelman School of Pharmacy; [3]UNC-CH, School of Medicine; [4]UNC-CH, Office of Interprofessional Education and Practice

Objective: The Office of Interprofessional Education and Practice (OIPEP) at the University of North Carolina at Chapel Hill established a Student Executive Committee (SEC) to engage students in interprofessional activities. The SEC is comprised of students from the health professional schools (Allied Health, Dentistry, Medicine, Nursing, Pharmacy, Public Health, Social Work), the Schools of Education, Business, and the Health Sciences Library. *Debunk the Junk was* the first SEC initiative – an interprofessional, case-based event where participants addressed myths about their professions and leveraged their developing expertise while establishing roles and responsibilities for collaborative practice as outlined by the Interprofessional Core Collaborative (IPEC).[1]

Methods: Students from Dentistry, Nursing, Pharmacy, Public Health, and Allied Health professions collaborated on a case from MedEd Portal.[2] The Dental Foundation of North Carolina (DFNC) and OIPEP sponsored the event. Students and faculty were recruited through existing Interprofessional Education (IPE) interest groups at their respective schools. After the event, participants completed a survey evaluating their pre-post perceptions of IPE using the Nebraska Interprofessional Education Attitudes Scale (NIPEAS). The NIPEAS is a 19 item Likert Scale that measures students' attitudes toward IPE using four themes.[3] Quantitative data was analyzed using a Wilcoxon Signed Rank Test. Qualitative data was coded to identify participant takeaways and suggestions for improvement.

Results: Of the 71 attendees, 53 completed the survey (response rate = 75%). The average responses to the pre and post survey questions increased. There was a significant difference in responses in all but one question ($p<0.05$). There was no significant difference in participants' perception of "…communication [as] an essential component of all treatment plans" ($p>0.05$).

Conclusions: *Debunk the Junk* was an innovative, student-led IPEP initiative that reinforced participants' understanding of the importance of and desire for IPEP while clarifying the roles that different professionals play in a healthcare team.

Funding: DFNC and OIPEP

(39) Qualitative Evaluation of a Group-Messaging Application in Medicine and Dentistry: Educators' Perspectives (Phase 1)

Giwa J[1], Kopczynski K[1], Davis M[1], Laxer K[2], Bryant A[3], Chuang A[3], Mihas P[4], Quinonez R[1]

[1] Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]The Ohio State University, [3]University of North Carolina School of Medicine, [4]The Odum Institute

Objective: Educators continually strive to identify effective and engaging tools for student learning. In this study, GroupMe, a free group-messaging application was applied in an interprofessional context to promote medical and dental students' learning. From 2018-2019,

dental students from the UNC Adams School of Dentistry remotely facilitated prenatal oral health case-based discussions with medical students during their obstetrics and gynecology block, using GroupMe. This study evaluated educators' perspectives on the effectiveness of GroupMe as a learning tool within the context of prenatal oral health.

Methods: Using a sequential, exploratory mixed methods study, we obtained qualitative data (phase 1), which included semi-structured interviews with course instructors (N=3) and dental student case coordinators (N=4) participating in GroupMe cases. Qualitative findings from educators' perspectives on this learning tool are presented.

Results: A total of 130 medical students participated in 9 sessions using GroupMe during the study period. Opportunities and challenges emerged in these interactions. This method allowed students the flexibility to learn subject material remotely and review on their own time. On numerous occasions, participation by medical students was limited, greatly diminishing the value of the experience for dental student facilitators. The level of participation from medical students seemed to be heavily contingent upon the degree to which their medical teaching assistants were engaged in the discussion. Coordinating dental and medical school schedules to find an optimal time to discuss prenatal oral health created an additional barrier to the success and periodicity of the GroupMe cases.

Conclusion: GroupMe represents a novel, promising platform for interprofessional education. This learning medium may appeal particularly to introverted students and would likely be more effective if medical student participation was incentivized or required. GroupMe is most effective when participants are sufficiently engaged, and when the schedules of medical and dental students align.

(40) Could Collaboration between Emergency Room Clinicians and Dentists Effectively Treat Patients with Acute Dental Pain?

Giwa J[1], Harrison B[2], Ciarrocca K[1], Reside G[1], Matthews N[1], Phillps C[1], White R[1]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Biomedical Engineering, University of North Carolina at Chapel Hill

Background: An unintended outcome of widespread prescribing of opioid analgesics is the large number of left-over opioid doses and their misuse.

Problem: Emergency department (ED) clinicians are often confronted by patients with acute dental pain. In a study 33-month study of almost a million Medicaid beneficiaries treated in EDs across 13 U.S. states, opioids were prescribed at least half the time for acute dental conditions. In a NC convenience sample of 85 Physicians or Physicians Assistants from a UNC IRB approved Qualtrics survey in 2019, 33% prescribed an opioid analgesic for acute dental pain, rated 8 of 10 in a clinical scenario of otherwise healthy patients. With the same scenario 16% (n=20) of NC Endodontist prescribed opioid analgesics as did 15% of NC General Dentists.

Recommendation: A consultation network can be established between a hospital ED or urgent care center and a dentist on-call using Telemedicine/Teledentistry, communicating through HIPPA dedicated ZOOM, I-Phone, or Facebook's Portal. The dentist at a remote site need not be responsible for the patient's treatment beyond the consultation. Collaboration between ED clinicians and dentists could reduce the number of prescribed opioid analgesic doses while accomplishing the goal of moderating acute dental pain. This form of interprofessional education and practice offers a way to improve health care outcomes in the United States.

Treatment Options: Alternatives to opioid analgesics in treatment of acute dental pain include: 1) Scheduled doses of non-steroidal analgesic (NSAIDS) supplemented with acetaminophen 2) Long-acting local anesthetic (liposomal bupivacaine) to moderate acute pain for at least 48 hours allowing patients time to seek definitive treatment.

Conclusion: Interprofessional education and practice enabled by tele-medicine could further the goal of reducing the numbers of opioids in circulation, while effectively moderating acute dental pain with alternatives to opioids.

(41) Analysis of an Innovative Dental Hygiene Clinical Evaluation System

Harmon JB, Kornegay EC, Brame JL

Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: This study was conducted to assess student and faculty perceptions regarding impact and integrity of an innovative clinical evaluation system in the UNC-CH Adams School of Dentistry Dental Hygiene Program.

Methods: This study used a mixed-methods design with a Qualtrics survey and debriefing sessions. All senior dental hygiene (DH) students (N = 36) and clinical DH faculty (N = 15) were asked to participate. Cohort-specific surveys included inquiry of demographics, Likert-scale questions to gauge perceptions regarding impact and integrity of the new system, and open-ended questions. Debriefing sessions included discussions regarding opinions and feedback. Survey responses were compared using descriptive statistics. Open-ended responses and debriefing comments were assessed to evaluate for common themes.

Results: All DH students and 10 faculty (67%) completed the survey. Findings revealed that 81% (N=29) of students and 90% (N=9) of faculty preferred the new clinical evaluation system. Eighty-three percent (N=30) of students and 100% of faculty agreed the new system enhanced faculty calibration. Eighty-three percent (N=30) of students and 90% (N=9) of faculty agreed it fostered a learning-centered environment and resulted in a more accurate reflection of performance compared to the previous evaluation system. Open-ended and debriefing comments revealed an increase in quantity and quality of faculty feedback that promoted a positive educational experience. Both groups noted an increase in the emphasis of patient-centered care rather than a grade-centered focus. Students reported a decrease in stress as related to asking questions and grade outcomes, and preferred the pass-fail grading method. While improvement in faculty calibration was generalized, a need for continued calibration was noted by students.

Conclusion: Student and faculty feedback showed strengths and improvements with implementation of a new clinical evaluation system. A focus on feedback rather than a numerical score showed development of collegial relationships, a growth mindset, and a patient-centered care environment.

Funding: UNC School of Dentistry Educational Research Grant, Adams School of Dentistry, University of North Carolina at Chapel Hill

(42) Promoting Early Childhood Oral Health in Clinical Practice: Development of a Smartphone Application

Allen AA[1], Wright JT[1], Saemundsson SR[1], Divaris K[1], Ryoo K[2], Quinonez RB[1]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Learning Sciences, School of Education, University of North Carolina at Chapel Hill

Objectives: Educational technologies offer opportunities to enhance learning experiences and outcomes in pediatric dental education. This project aimed to 1) develop an instructional smartphone application (app) based on UNC's Baby Oral Health Program and 2) determine its acceptability and effectiveness for early childhood oral health education.

Methods: App design followed established processes, including evaluation and iterative revisions based on learners' and content experts' feedback. Participants were 64 third-year dental students (54% female, mean age=26 years), randomly allocated to intervention (app-) and control (article-based) groups. Study participants were surveyed the week leading up to (pre-) and at the day of testing (post-) in five domains: perceived value, knowledge acquisition, comfort, stage of readiness to see infants/toddlers in clinical practice and clinical reasoning. Data analyses included descriptive and bivariate testing methods based upon non-parametric (Wilcoxon) tests, and a conventional $P<0.05$ statistical significance criterion.

Results: There were substantial improvements in all examined learning outcome domains in the app group, whereas positive changes of smaller magnitude were found in the control group. Gains in knowledge acquisition ($P=0.0005$), comfort ($P=0.03$), overall comfort ($P=0.02$) and clinical reasoning ($P=0.01$) were significantly higher in the app versus the control group. Virtually all (≥90%) of students reported that the app content was useful, contained suitable images, functioned well, and added value to their education.

Conclusion: Dental student learners perceived smartphone app-based education favorably. Its educational benefits in terms of knowledge acquisition, comfort, and clinical reasoning are superior compared to a control, article review-based, instructional approach.

Keywords: dental education, educational technology, early childhood oral health, clinical reasoning, traumatic dental injuries

Funding source: Supported by the Hillsdale Fund, Greensboro NC, and the bOHP Fund, Adams School of Dentistry, University of North Carolina at Chapel Hill

(43) Teaching Methodologies for Implementation of Ergonomic Operator and Patient Positioning

Faust AM[1], Johnston LB[2], Ahmed SN[1], Harmon JB[1].

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Physical Therapy, School of Medicine, University of North Carolina at Chapel Hill

Objectives: The aim of this study was to assess the impact of inter-professional teaching on the application of skill sets related to operator and patient positioning in dentistry. Musculoskeletal disorders (MSDs) are prevalent among dentists. Knowledge of correct operator and patient positioning promotes safe working postures that can prevent the development of MSDs.

Methods: A randomized-case-control, study was conducted with 83 first-year dental students at the University of North Carolina - Chapel Hill Adams School of Dentistry. Forty-nine percent (N=41) of the students solicited for the project participated. All students participated in a didactic lecture on ergonomics and correct operator and patient positioning, along with a pre-clinical practice session with peer patients. During the clinical practice session students in the case group received an additional ten minutes of one-on-one instruction by a trained physical therapy student or dental faculty member. Two weeks later all students were assessed by a faculty member using a scored, picture-based, rubric on operator and patient positioning for restorative work on an anterior tooth, posterior mandibular tooth, and posterior maxillary tooth. Photographs were taken of each student in their final posture, while working on the maxillary arch, for post-analysis assessment.

Results: There was a statistically significant difference between the two groups with respect to the composite ergonomic positioning score ($p = 0.006$), operator shoulder abduction position ($p = 0.03$), and lateral flexion of the spinal column ($p = 0.02$).

Conclusions: Hands on instruction with physical therapists and trained dental faculty positively effects ergonomic compliance and provides students with tailored feedback that can be applied to clinical practice.

(44) Dental and Dental Hygiene Students' Knowledge and Attitudes Regarding Teledentistry

McLeod C[1], Adatorwovor R[2], Brame J[1], White A[3,4], Weintraub JA[3,4]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, [3]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [4]Department of Health Policy and Management, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objective: This study's purpose was to identify the knowledge and attitudes of teledentistry among the dental (DDS) and dental hygiene (DH) students in at the University of North Carolina at Chapel Hill (UNC), located in a state (North Carolina) where teledentistry is less developed in part because of policy restrictions.

Methods: A faculty presentation and video demonstration regarding teledentistry, followed by small group discussions and a large group debriefing session were conducted at the UNC Adams School of Dentistry. Participants completed an optional digital survey before and after the session. McNemar's matched pair test and Fishers exact test were used to compare the proportion of the participants' pre- and post-test responses.

Results: Survey participants (n=44) included 30 DH and 14 DDS students. A significant increase in students' knowledge of teledentistry ($p < 0.01$) was found. However, attitudes about the use of teledentistry and its adoption into DDS and DH curriculum showed no significant change because between 65% and 78% were in favor pre- and post-test, respectively. The majority of students identified simulated cases (59%), integration into DDS (55%) and DH (68%) community rotations as potential ways to adopt teledentistry into their curriculum. There was a significant difference in regards to attitudes of dental hygienists' role in the delivery of services through teledentistry ($P=0.0391$) and 89% of students identified restricted scope of practice as a barrier to the implementation of teledentistry in North Carolina.

Conclusion: The educational session resulted in significant increase in knowledge and demonstrated positive attitudes toward the adoption of teledentistry into DDS and DH curriculum. Students indicated that teledentistry should be adopted into multiple facets of their educational programs but a major barrier to its adoption into practice is the DH restricted scope of practice in North Carolina.

(45) Building a Foundation: Implementation of an Early Standardized Patient Encounter

Fearnow B[1], Moore Z[2], Wolcott M[3], Ciarrocca K[4].

Academic Affairs, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC

Objectives: Communication is an essential part of working in a clinical setting—we believe this skill can be cultivated as early as the first day of class. The purpose of this project is to describe the design, implementation, and evaluation of a standardized patient encounter for first year students.

Methods: At the UNC Adams School of Dentistry, we designed a 15-minute standardized patient interaction for first-year Doctor of Dental Surgery (DDS1) students. During this experience, students were paired with another classmate for the encounter. The interaction was scheduled prior to any formal training on how to conduct a patient interaction—the purpose was to allow students to explore patient interactions without pre-conceived expectations. They were instructed to obtain a chief concern in addition to a dental and medical history. Students completed a pre- and post-survey about their experiences and

self-efficacy. Students also received feedback from the standardized patient using a “start, stop, continue” structure, which was then followed by a large-group debrief as an entire class.

Results: Eighty-three DDS1 students completed the standardized patient interaction and pre-/post-surveys. On average, students were 68% confident they could obtain a chief concern before the interaction, which increased to 81% after the encounter. When asked about the experience, students reported it was a valuable experience (94% agreement) and that the experience helped them identify their weaknesses (98% agreement). In addition, most students reported the experience “not at all stressful” (45%) or “somewhat stressful” (50%). Feedback from standardized patients often discussed using less medical terminology, speaking more slowly, and maintaining more eye contact.

Conclusion: The use of a standardized patient interaction at the start of dental school offers a unique advantage—students found the opportunity valuable and it offered feedback that can help students grow as they become acquainted with clinical practice.

(46) Assessing Oral Health Content in Non-dental Professional Association Websites

Weintraub JA[1,2], Jamison AR[1], Rozier RG[2], Atchinson K[3]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Gillings School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA, [3]School of Dentistry, University of California – Los Angeles, CA, USA

Objective: Opportunities for existing non-dental practitioners to learn about oral health (OH) is unknown. One potential resource is a profession’s website. This study’s purpose was to assess websites of non-dental health professional associations to determine their OH content and if some types were more likely to include OH information.

Methods: Non-dental organizations were selected using lists provided by the Interprofessional Education Collaborative (IPEC), National Association of Advisors for the Health Professions, National Collaborative for Improving the Clinical Learning Environment, and recommendations from health profession school deans. Websites were reviewed by one author. A structured checklist was used to determine if there was an OH webpage, interest group or initiatives, information about OH CE courses, webinars, curricula, and/or links or OH resources on other sites. Where search functions were available, key dental terms were searched. Frequencies, chi-square, and Fisher extract test statistics were calculated. Some website content was inaccessible without membership.

Results: Of the 59 sites reviewed, 58% had any OH info; 37% were physician-related, 15% nursing-related, 31% were IPEC members. Ten (17%) associations had webpages, interest groups, or initiatives devoted to OH; 15% had information about CE courses or webinars with OH content; 4% included any OH curriculum information. When searching, some OH content or links were found on 63% of 51 searchable sites with the terms “oral hygiene” being most successful. Some information wasn’t education (e.g. member news). Considering categories of professional associations, there was no difference in presence of website OH content between IPEC members and non-member associations ($p=0.720$), or nursing-related vs other associations ($p=0.720$). Physician-related associations were less likely than others to include OH information ($p=0.045$).

Conclusion: To increase access to OH information, dental associations could help many non-dental professional associations increase their OH website content or add links to OH resources.

Imaging and Therapeutic Modalities

(47) Intraoral Radiographs – A Comparison of Dose Reduction with Collimation and Thyroid Shielding

Johnson B, LaPrade C

Adams School of Dentistry, University of North Carolina at Chapel Hill.

Objectives: A guideline set forth by the National Commission on Radiation Protection (NCRP) Report No. 145 recommends restricting dimensions of rectangular collimators used during intraoral radiographic imaging. In response to growing concern for the risks associated with dental diagnostic imaging, adoption of the concept of ALARA (As Low As Reasonably Achievable) has inspired multiple modifications in collimator design approaches for reducing patient dose. This intraoral study compared effective dose (E) using circular and rectangular collimator (RC) modalities.

Methods: Simulated 18 projection adult and 12 projection child full mouth series (FMX) were exposed using a 6 cm diameter circular collimator, a factory rectangular PID (Focus RC), and five alternative universal RC modalities; JadRad RC, Rinn RC, Durr RC, DexShield RC, and TruAlign RC, for both adult and child phantoms. Dosimetry was acquired using optically stimulated luminescence (OSL) dosimeters placed at 24 anatomical sites in the head/neck region. Exposures were made with a Focus Instrumentarium Intraoral source using 70 kVp and total mAs of 5.34 (adult) and 2.7 (child).

Results: Mean E was lowest for Focus RC (54 μSv) which produced the greatest exposure area reduction when compared to circular (51%) followed by JadRad RC (61μSv), Rinn RC (68μSv), Durr (69μSv), DexShield (79μSv), TruAlign RC (79μSv), and circular (90μSv). Child doses followed a similar trend: Factory RC (44μSv), JadRad RC (49μSv), Rinn RC (53μSv), Durr (53μSv), DexShield (60μSv), TruAlign RC (79μSv), and circular (92μSv). Thyroid shielding reduced equivalent thyroid dose by as much as 59% with Circular collimation.

Discussion: Factory rectangular collimation techniques yielded the greatest dose reduction when compared to alternative rectangular techniques and circular. However, collimator dimensions, in addition to shape, should be considered as a significant factor in affecting patient effective dose. Rectangular collimation alone yielded a greater reduction in thyroid dose than did circular collimation with thyroid shielding.

Funding: Dean's Pre-Doctoral Promising Research Award

(48) SIOT and Transillumination in Detection of Proximal Caries

Stewart I[1], Broome A[1], Mahn Arteaga GE[2], Gupta S[2], Al-Rawi B[2], Moss K[3], Ferreira Zandona A[4], Ribeiro AA[1]

[1]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2] Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [4]Department of Comprehensive Care, School of Dental Medicine, Tufts University

Objectives: Detection of proximal caries lesions is difficult due to anatomic location. Digital bitewing radiography suffers from low sensitivity, but has high specificity for caries detection; and digital LED transillumination has shown high concordance with bitewings. First-generation Stationary Intraoral Tomography (s-IOT), using carbon nanotube technology and a direct intraoral detector for acquiring images at a similar radiation dose to standard bitewings, shows promise in caries detection by generating parasagittal slices with an iterative reconstruction algorithm. This study aimed to compare s-IOT to bitewings and

transillumination to determine the reliability of this system as an adjunct method (to visual exam) for proximal caries detection.

Methods: Extracted permanent posterior teeth (n=64) with proximal surface lesions ICDAS scored 0 to 4 were mounted in a phantom head for imaging and examination. Three trained examiners scored the surfaces by visual examination combined with: 1) s-IOT, 2) digital bitewings, and 3) LED transilluminator, independently. All exams were repeated after a 3-week interval. Teeth were sectioned longitudinally in a mesio-distal direction, providing two 1.5mm thick slices from each proximal surface. Then, the sections were examined with x15 magnification under stereomicroscopy for histological gold-standard.

Results: Inter-examiner kappa scores were 0.36; 0.32 and 0.33 for digital bitewings, sIOT and LED transilluminator, respectively. Digital bitewings showed the highest scores for sensitivity versus sIOT and LED transilluminator (56.4%; 48.7% and 46.2%, respectively), while LED transilluminator showed the highest scores for specificity (91.7%) versus sIOT (87.5%) and digital bitewings (83.3%).

Conclusions: The three methods performed with small differences between sensitivity and specificity, indicating that sIOT and LED transillumination are comparable to digital bitewings for the detection of proximal caries. Since inter-examiner kappa scores showed fair agreement, we hypothesize that a more robust training and calibration is necessary, since past studies showed a sensitivity advantage of the sIOT over bitewings.

Funding: Dora Lee and John C. Brauer Research Fund, Adams School of Dentistry, University of North Carolina at Chapel Hill

(49) Feasibility of Serving Personalized 3D Dentition Models for Communicating Tooth Surface-Level Conditions

Spangler HD,[1] Ferreira Zandona AG,[2] Simancas-Pallares M[3], Ginnis J[3], Divaris K.[3,4]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, University of North Carolina at Chapel Hill, [2]Department of Comprehensive Care, School of Dental Medicine, Tufts University.[2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [4]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill,

Objective: To understand and convey the location of distinct tooth surfaces is an essential component of communication in dentistry. Existing solutions are limited in conveying information to patients and can quickly become verbose when describing many surfaces simultaneously. We sought to develop a process for re-texturing (coloring) a 3D dentition model to represent tooth surface-level characteristics such as dmfs information and oral hygiene scores. Here, we present the development of the pipeline and the results of a comparison between a server-based implementation against local machine processing for generating personalized pediatric models at scale.

Methods: We departed from a model of complete pediatric dentition (72,597 total polygonal surfaces). We used UV mapping within the open source tool *Blender* to section and unwrap each tooth along its individual line angles, and link the resulting 2D surfaces to distinct regions on a 1024x1024 pixel JPG format image file. These distinct regions corresponded to mesial, distal, buccal, lingual, and occlusal surfaces. One JPG was used per tooth. Then, we wrote a blender addon script which reads dmfs data from an excel file using python core library *xlrd*, uses it to dynamically update tooth surface colors within each image file through the python imaging library (PIL) and uploads the result to sketchfab.com via Blender's *bpy* interface. This script was run on 56 different pediatric dentition samples to obtain and compare timing characteristics.

Results: Local generation of a model took an average of 286ms (SD=13). Generating, uploading to, and retrieving a model from sketchfab.com took substantially longer (t-test $P<0.05$), an average 8.25s (SD=0.52).

Conclusion: These data suggest that a server-based solution is feasible and relatively fast. Considering installation on an in-house server should mitigate the observed discrepancies via reduction in network delay, a server-based implementation is expected to be a capable design.

Funding Source: Grover C. Hunter Research Fellowship, the parent study is supported by a grant from the NIH/NIDCR #U01-DE025046

(50) A Comparison of Contemporary Portable X-ray Systems

Dillon JR[1], Johnson KB[1], Broome A[1], Ivanovic M[2], Ludlow JB[1]

[1]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Radiology, School of Medicine, University of North Carolina at Chapel Hill

Objectives: There is substantial evidence for a cumulative dose-related response to ionizing radiation in the form of cancer developing years after initial exposure. Therefore, this study focused on effective dose(E), a quantity with direct correlations to biologic risk from dental x-ray exposures. The purpose of this study was to measure doses and calculate E from adult FMX examinations using handheld and conventional wall-mounted x-ray sources with both circular and rectangular collimation(RC).

Methods: A human tissue-equivalent phantom and optically stimulated luminescent dosimeters were used to measure dose from simulated FMX exams(n=18) at 24 head/neck tissue sites. Exposure parameters used were 70 kV/7mA(0.84mAs & 1.34mAs) for Conventional Circular and RC, 60 kV/2.5mA(2.16mAs) for NOMAD Circular and RC handheld and 60 kV/2.0mA(1.98mAs) for Xray2Go Circular(XTG) handheld. ANOVA and Tukey HSD statistics were used to demonstrate significant relationships.

Results: FMX exam E(uSv) was NOMAD RC(6.9), Conventional RC(12.4), XTG(16.7), NOMAD Circular(17.4), and Conventional Circular(26.3). For circular techniques, handheld E was significantly lower than conventional for both devices($p<0.0001$). With RC, E was significantly lower than all circular techniques($p<0.0001$). Significant differences in E were found for all modality combinations except NOMAD Circular and XTG($p=0.8329$). Operator groin exposure was significantly higher(60-90%) than thyroid, chest and trigger hand, which were indistinguishable from ambient background levels, for all handheld modalities($p<0.0001$).

Conclusion: Handheld E was at least 34% less than conventional circular and as much as 74% less with the use of RC. Operator exposure to groin can increase significantly from over-angulating handheld sources; however, addition of RC can reduce this exposure by as much as 76%.

(51) Detecting Apical Radiolucencies Using Deep Learning Technology: A Pilot Study

Hamdan MH[1], Mol A [1], Tawil PZ [2], Tuzova LN [3], Tuzoff DV [3], Tyndall DA[1].

[1]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2] Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3] Denti.AI Technology Inc., Ontario, Canada

Objectives:
- Assessing the diagnostic performance of a computer-aided deep learning detection system at detecting apical radiolucencies on periapical radiographs.
- Evaluating the diagnostic performance of three board-certified experts in OMF Radiology

and Endodontics for the same task.
- Comparing the performance metrics of the deep leaning software and expert observers.

Methods: The UNC Adams School of Dentistry- Oral and Maxillofacial Radiology CBCT referral database was searched for all CBCT volumes acquired from 08/25/2014 to 3/24/2019 for Endodontic purposes. The inclusion criteria consisted of CBCT-evident apical radiolucencies that measured above 2 mm at their widest diameter. CBCT served as the gold standard, but each radiolucency was included only if it had a periapical projection acquired no more than six months apart. The periapical projections had to be diagnostic with no major artifacts precluding the detection of the apical sites. All patients were above 18 years of age. The search yielded a total of 184 positive intraoral images which were de-identified and uploaded to the deep learning diagnostic software (Denti.Ai Toronto, CA). The positive set was annotated for CBCT-proven apical radiolucencies. An additional set of 132 intraoral images without apical radiolucencies were uploaded to serve as control. In order to adapt the model to intraoral images acquired at UNC, 54 images from the positive set were used. The remainder 130 images from the positive set and 132 from the negative set were considered as testing subsets and were not used for training purposes. A pilot testing subset consisting of 70 images, was randomly selected from the positive and negative sets. Three expert-observers were calibrated and asked to view and annotate the pilot testing set independently. A (1-5) Likert scale to indicate level of confidence was used. Their performance at this task was later analyzed and compared with the performance of the diagnostic software.

Results: The standalone software performance (by tooth) results were as follows: sensitivity was 93%, specificity was 88% while ROC-AUC was 94% (95%CI: 89%,-98%). Whereas the experts combined performance results were as follows: sensitivity was 87%, specificity was 97% while ROC-AUC was 93% (95%CI: 88%,-98%). Notably, sensitivity varied by location of the radiolucency in the arch. The software performance metrics were lowest in the maxillary posterior region.

Conclusion: Using a limited testing dataset, AI provided comparable performance to expert observers for this task. Further AI training is necessary to increase the sensitivity and specificity of AR detection in the posterior maxillary region.

(52) Comparison of Regional Superimposition Techniques: Accuracy and Precision of Methodologies

Zermeno JP[1], Chung CJ[2], Tejera B[3], Nguyen T[1]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Orthodontics, Gangnam Severance Dental Hospital, Seoul Korea; Institute of Craniofacial Deformity, College of Dentistry, Yonsei University, Seoul, Korea, [3] Adams School of Dentistry, University of North Carolina at Chapel Hill.

Objectives: The objective of this study is to compare maxillary superimpositions using skeletal landmarks established by Bjork against palatal rugae.

Methods: T1 and T2 Cone Beam Computed Tomography (CBCT) scans and intraoral scans were obtained for 15 patients treated with maximum incisor retraction. T1 and T2 scans of the teeth were registered to their corresponding CBCTs to create accurate dentition and reoriented into a common coordinate system. Voxel-based registrations were performed using Bjork structures. Surface-based registrations were performed using rugae. Differences between the 2 superimposition methods were compared and analyzed using a paired t-test.

Results: The mean difference in anteroposterior changes at the incisor and molars were 4.94mm and 4.50mm, respectively. The mean difference in vertical changes at the incisors and molars were 1.15mm and 2.94mm.

Conclusion: Maxillary regional superimposition using Bjork structures produced different dental changes compared to superimpositions using the rugae.

Funding: SAO Resident Research Grant

Population and Epidemiology

(53) Developmental Defects of the Enamel Among Preschool-Age Children

Burk Z[1], Ginnis J[1], Simancas-Pallares MA[1], Shrestha P[1,2], Agler CS[3], Ferreira Zandona AG[4], Divaris K[1,2]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, [3]Division of Oral and Craniofacial Health Sciences, [4]Department of Comprehensive Care, School of Dental Medicine, Tufts University

Objectives: Developmental defects of the enamel (DDE) are a family of heterogeneous, non-carious, conditions of developmental origin. They affect the quantity, quality or appearance of dental enamel and may predispose to dental caries development; however, little information exists about their prevalence, types and distribution among preschool-age children. In this study, we sought to a) characterize DDE among a community-based sample of preschool-age children, and b) examine the association between DDE subtypes and early childhood caries (ECC).

Methods: We used tooth surface-level clinical examination data from a statewide sample of 6,404 children (mean age=53 months) participating in an epidemiologic study of early childhood oral health (ZOE 2.0) in North Carolina. Calibrated examiners conducted clinical examinations using a standardized protocol for dental caries (ECC was defined as ICDAS>2). DDE were assessed on the facial/buccal surface of all teeth using the modified DDE epidemiologic index of Clarkson and O'Mullane, recording conditions ≥1mm according to type: demarcated opacities, diffused opacities, hypoplastic defects and their combinations. Analyses relied upon descriptive statistics and log-binomial regression to estimate the association between DDE and ECC prevalence.

Results: Two-thirds of children (n=4,293) had ≥1 surface with a DDE—among those with DDE, the mean number of affected surfaces was 4. Demarcated opacities were the most common defects (found in 49% of participants), followed by diffuse opacities (42%) and hypoplastic defects (17%). Most commonly affected teeth were molars (61%), followed by canines (23%) and incisors (17%). We found a weak positive association between any DDE and ECC (PR=1.14; 95% CI=1.08-1.20)—this association was most pronounced for hypoplastic defects (PR=1.17; 95% CI=1.12-1.23).

Conclusion: DDE are common among preschool-age children. The finding of a positive association of DDE, particularly hypoplastic defects, and ECC could be partially explained by diagnostic misclassification; nevertheless, it corroborates previous evidence linking hypoplastic enamel defects with ECC risk.

Funding Source: NIH/NIDCR U01-DE025046 and Grover C. Hunter Research Fellowship

(54) Parents' Education Influences their Reports of Children's Oral Health Status

Imes E[1], Ginnis J[2], Simancas-Pallares M2[2], Shrestha P[2,3], Ferreira Zandona AG[4], Divaris K[2]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, [4]Department of Comprehensive Care, School of Dental Medicine, Tufts University

Objectives: Parents are responsible for their young children's oral health and care and their perceptions of their children's oral health status (OHS) are crucial as they can influence oral health-related behaviors and dental care-seeking. Our objectives were to a) quantify the correlation between parents' assessments and their children's clinically-determined oral health status, and b) investigate parent demographic characteristics possibly influencing this association.

Methods: We used parent reported and clinically-assessed information for oral health status among a community-based sample of 6,404 children (mean age=53 months) enrolled in Head Start centers in North Carolina and participating in an epidemiologic study of early childhood oral health (ZOE 2.0). Children's OHS was reported by parents on a five-level scale: "excellent", "very good", "good", "fair", "poor". Children's clinical diagnosis [i.e., early childhood caries (ECC)] was based upon clinical examination data obtained by trained and calibrated examiners using visual criteria—ECC was defined as ICDAS>2. The agreement between reported and clinically-assessed oral health status was estimated using Spearman's rank correlation (*rho*) and Kendall tau c (τ_c) coefficient, and corresponding 95% confidence intervals were obtained with bootstrapping.

Results: Most parents reported their children's OHS as very good (n=2,507, 31%) or good (n=2,439, 31%), with only 15% reporting it as fair/poor. Overall, there was a significant correlation between parents' reports and ECC (*rho*=0.39; 95% CI=0.37-0.41; τ_c=0.43): ECC prevalence among those with 'poor' OHS was 95% versus 29% among those with 'excellent'. Parents' Hispanic ethnicity did not modify this association. However, parental education was significantly associated with the level of agreement between reported and clinically-assessed OHS: less than high school education--(*rho*=0.30; 95% CI=0.25-0.35; τ_c=0.32) *versus* high school education or more (*rho*=0.40; 95% CI=0.37-0.42; τ_c=0.44).

Conclusion: These results suggest that low parental education, beyond itself being a risk factor for ECC, is associated with parents' diminished potential to recognize or report it.

Funding: NIH/NIDCR U01-DE025046

(55) Periodontal Disease, Undiagnosed Diabetes and Body Mass Index: Implications for Diabetes Screening by Dentists

Philips KH[1], Zhang S[2], Moss K[1], Ciarrocca K[3], Beck JD[4]

[1]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Periodontics Department, College of Dentistry, University of Iowa, [3]Division of Diagnostic Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [4]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill,

Objectives: Periodontal disease and diabetes mellitus are two highly prevalent associated conditions with implications for both oral and overall health. Fifty percent of adults with diabetes worldwide are undiagnosed. We determined if periodontal disease was independently associated with undiagnosed diabetes and rates of undiagnosed diabetes in a population-based study.

Methods: Logistic regression was used to calculate adjusted odds ratios (OR) and 95% confidence intervals (CI) for participants from Atherosclerosis Risk in Communities study visit 4 (n=6085). Undiagnosed diabetes was defined as no self-reported diabetes ("Has a doctor ever said you had any of the following? Diabetes [sugar in the blood]?") and blood glucose levels (fasting$\geq$126mg/dL or Oral Glucose Tolerance Test>200mg/dL). Periodontal disease was defined using PPC-Stages (Periodontal Profile Classes). Further, an interaction model was performed for BMI.

Results: Individuals with severe periodontal disease and people who go to the dentist irregularly were, respectively, 64% and 44% more likely to have undiagnosed diabetes. Undiagnosed diabetes rates overall were 5%; 9.2% in obese and 3.1% in non-obese dental patients, which increased to 9.7% and 4.8%, respectively in those with periodontal disease. Further, severe periodontal disease was significantly related to undiagnosed diabetes in individuals with underweight OR 3.19(95% CI;1.15-8.82), normoweight OR 2.60(1.19-5.69), and overweight OR 1.94(1.14-3.31) but not obese BMI OR 1.51(0.91-2.49).

Conclusion: The periodontal disease-undiagnosed diabetes relationship was modified by BMI with the relationship being weaker in obese individuals as obesity likely overrides the periodontitis effect. The highest diabetes detection rates occurred in obese individuals and non-obese individuals with periodontitis but screening all patients would yield additional benefit. Considering that many US adults visit a dentist but not a physician annually, diabetes screening by dentists may benefit overall health.

(56) Prevalence of Peri-implantitis and Peri-implant Mucositis: A Review of Electronic Health Records

Glavich DM[1], Conner CD[1], Martinez Luna AA[1], Serag M[1], Gay IC[1], Camargo GA[1], Wu Q[2], Paquette DW[1], Gillone A[1]

[1]School of Dental Medicine, East Carolina University, Greenville, North Carolina, United States, [2]College of Allied Health Sciences East Carolina University, Greenville, North Carolina, United States

Objectives: The aim of this retrospective study was to examine the prevalence of peri-implant disease in a cohort of patients treated over a monitoring period of 7.5 years at nine networked dental school clinics sited in rural North Carolina (NC) communities.

Methods: Electronic health care records (EHRs) were searched for adult patients (>18 years) who had a full mouth periodontal examination and pre-existing or placed dental implants from September 2011 to April 2019. Case definitions were applied based on the recent classification of periodontal and peri-implant diseases. Peri-implant mucositis was defined as the presence of bleeding on gentle probing. Peri-implantitis was defined as the presence of bleeding on gentle probing and probing depths of >6 mm.

Results: A total of 1,327 implants in 657 patients were identified meeting inclusion criteria over the study period. Seventy (5.3%) implants were diagnosed as having peri-implantitis, and 160 (12%) implants were diagnosed as having peri-implant mucositis. At the patient level, 54 (8.2%) patients were classified with peri-implantitis, 117 (17.8%) patients were classified with peri-implant mucositis, and 507 (77.2%) were classified as healthy. Proportions of implants diagnosed with peri-implant disease were compared between subgroups defined by patients' age, gender, race, ethnicity and implant site. Age and gender were not statistically associated with a higher prevalence of peri-implant disease ($p=0.77$ and $p=0.42$, respectively). Implants placed in the posterior mandible were associated with a lower prevalence of peri-implant disease ($p<0.01$) versus other anatomic areas, while being Hispanic (versus Non-Hispanic) or African American (versus White) was associated with a higher prevalence ($p<0.05$). A multiple logistic regression analysis showed that smoking, type 2 diabetes, age, gender, race and ethnicity were not associated with increased prevalence for peri-implant disease while a posterior mandible location appeared to be associated with lower risk of peri-implant disease ($p<0.01$). All analyses were adjusted for possible correlations of implants within each patient.

Conclusion: The present analysis of EHR data confirms a low prevalence of peri-implant disease among NC adults with implants seeking dental care in an academic setting. In addition, the data indicate that anatomic site is more predictive of peri-implant health versus disease as compared to patient demographic factors for this population.

(57) An Environmental Scan of Dental Medicaid Coverage for Pregnant Women by State

Eke C[1], Mask A[1], Quinonez R[2], Reusch C [2]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [2] Children's Dental Health Project

Objective: Limited data exists informing policy changes to improve dental benefits for pregnant women. This study surveyed availability and extent of Dental and Medical Medicaid coverage to pregnant women across the United States.

Methods: Medical and Dental Medicaid coverage for pregnant patients were reviewed for all jurisdictions nationwide (2019). Information was gathered from state Medicaid websites and interviews with state Medicaid personnel, consisting of program policies regarding covered services, length of coverage, administrative practices, and details pertaining to each category of coverage.

Results: All states (100%) provide Medical Medicaid coverage for pregnant patients, with coverage ending at 60 days postpartum. Qualification for coverage varies by state, with coverage based on a prescribed percentage of the federal poverty level. Percentages ranged from 64% for pregnant patients to 198% for adults.

The majority (96%) of states provide Dental Medicaid coverage; however, the scope of coverage, particularly for pregnant women, varies. Some form of coverage is available to pregnant women in 48 states and the District of Columbia. The range of services varies considerably from state to state, with 22 states (44%) offering extensive dental benefits. The length of coverage for pregnant women varies considerably, with the majority of states (78%) offering 60 days postpartum coverage, nine states (18%) ending coverage at birth, and two states (4%) offering no coverage.

Conclusion: For many women pregnancy, Dental Medicaid coverage offers a time to re-enter the dental care system and address years of dental neglect. However, coverage is highly variable, ranging from non-existent in some states, to 90 days postpartum; with Dental Medicaid coverage being limited in scope and not mirroring benefits provided for other medical services. Given the relationship between maternal and child oral health, aligning benefits can help address a barrier to the oral health of this population.

(58) Oral Health-Related Quality of Life in Children Treated with Silver Diamine Fluoride: A Preliminary Report

Kopczynski K,[1] Baker C,[1] Purvis R,[2] Moore D,[2] Meyer BD[1]

[1]Division of Pediatric and Public Health, School of Dentistry, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [2]Charlotte Pediatric Dentistry, Charlotte, NC, United States

Objectives: Non-surgical strategies for managing early childhood caries (ECC), such as silver diamine fluoride (SDF), have recently gained traction in pediatric dentistry as part of caries management programs. The impact of SDF on oral health-related quality of life (OHRQoL) remains largely unexplored. This study evaluates the impact that SDF has on OHRQoL for children affected by ECC.

Methods: Caregivers of children under 6 years of age at a multi-center private practice in Charlotte, North Carolina were enrolled for this cross-sectional report. Data presented represents pre-treatment data collected. Caregivers completed the 13-item Early Childhood Oral Health Impact Scale (ECOHIS) and a demographic survey. Child behavior and dental treatment plans were recorded, and all data were compared across five groups: (1) in-office treatment with SDF (N=10), (2) in-office treatment with SDF followed by treatment using hospital-based general anesthesia (N=17), (3) conventional, in-office restorative treatment (N=31), (4) restorative treatment using hospital-based general anesthesia (N=35), and (5) a

control group of children requiring no treatment (N=69). Analysis was confined to descriptive statistics (means, standard deviations, and frequencies) and bivariate methods (student t-tests and Pearson chi-squared tests, as appropriate).

Results: Aside from age and family income, the five groups were similar according to all demographics. At baseline, the ECOHIS revealed significant difference across groups on the item of family guilt (*P= 0.027*). For this item, children receiving SDF in addition to treatment under general anesthesia scored the lowest, followed by the SDF group, the general anesthesia group, the conventional group, and the control group. All other items demonstrated no significant difference between groups.

Conclusion: This pre-treatment data shows similarities among the five study groups with respect to demographics and OHRQoL. However, the study is ongoing, so we cannot fully compare the degree to which various caries management strategies succeed in improving OHRQoL among pediatric dental patients and their families.

(59) National Comparison of Pediatric Dental Treatment Decisions by Practice Environment

Townsend DW[1], Azevedo CB[2], Rodrigues J[2], Jain S[3], Zandona AF[3], Saemundsson SR[6]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]School of Dentistry, Federal University of Rio Grande do Sol, [3]Tufts School of Dental Medicine

Objective: Determine the impact of practice environment on treatment decision in the primary dentition.

Methods: A survey was sent to 7934 (dental school faculty, AAPD members, and private practice dentists). Participants were presented a series of 10 clinical cases with varying degrees of severity (ICDAS 2-6), each presented as two scenarios, with and without radiographs via Qualtrics survey and provided a bank of non-invasive and/or invasive treatment options. Non-invasive treatment options ranged from no-treatment, fluoride and dental sealants, and invasive treatment options ranged from filling to crown and extraction. Clinically, 1 lesion was ICDAS 2, 1 ICDAS 3, 4 ICDAS 4, 3 ICDAS 5, and 1 ICDAS 6. Radiographically, 6 of 10 lesions penetrated the outer dentinal 1/3, 1 the middle 1/3, 3 the inner 1/3. Comparisons of treatment decision between groups (dental school faculty, private practice and corporate dentists) were performed per scenario.

Results: Out of the 7934, response rate was 12.9% (N=1026) with 834 qualified responses. Participant's age ranged from 25 to 82 (6.9% were 25-29; 34.7% 30-39; 20.9% 40-49 years; 15.9% 50-59; and 21.6% 60+). Participants were analyzed with respect to their clinical environment: private practice, academic, corporate practice, or a combination thereof. In 98% of group comparisons, there was no significant difference in treatment decisions. Clinicians that worked in a combination of private practice, academic, and corporate practice environments treated patients differently than those that worked in private practice ($P < 0.05$) in 35% of scenario presentations.

Conclusion: In almost all comparisons of treatment decisions in the tested clinical environments, there were no statistically significant differences between practitioners. The few statistical significant results found can be explained by the chance occurrence of significance in multiple comparisons and no practical significance can be attached.

Funding: This research was supported by the Grover C. Hunter research fund fellowship.

(60) Lifestyle Factors that Effect Self-Perceived Health in HIV+ Individuals Receiving Comprehensive Dental Care

Williams B[1], Weideman AM[2], Ramsey K[1], Blake J[1], Southerland J[3], Webster-Cyriaque J[1]

[1]Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]UNC Center for AIDS Research, [3]Meharry Medical College School of Dentistry

Objectives: Inadequate dental care can significantly compromise the health and well-being of those with human immunodeficiency virus (HIV). This longitudinal study investigated the impact of comprehensive dental intervention on quality of life using a validated short form-8 (SF-8) in patients with HIV. Mental composite scores (MCS) and physical composite scores (PCS) ranged from 0 (poor) to 100 (excellent).

Methods: 196 subjects were divided into 3 groups: newly diagnosed (≤1 year since HIV diagnosis/no regular dental care n=63), previously diagnosed (>1 year since HIV diagnosis/ no regular dental care n=68) and historical (>1 year since HIV diagnosis/ receiving regular dental care n=65). Dental prophylaxis/ debridement, oral hygiene instruction, and interviews were conducted that included the SF-8, factors affecting oral health, HIV status and demographics at 6 month intervals for 24 mo. Comprehensive dental care was provided.

Results: The majority of subjects were male (75.0%) and African-American (59.8%) with a median age of 43.4 years. At baseline, although 80.6% of participants report taking ART, only 46.2% of these participants were virally suppressed (< 50 copies/mL) at the most recent laboratory visit. Although viral load was not significantly associated with SF-8 scores in the longitudinal data, interestingly, patient-reported ART was strongly associated with mental self-perceived wellness (p=0.0004, Wald chi-square). This association did not depend on oral care provision or date of diagnosis. Compared to patients who were either unemployed or disabled, those patients who were employed scored, on average, 5.4 points higher (p<0.0001, Wald chi-square) on the MCS and 3.27 points higher (p=0.0003, Wald chi-square) on the PCS. Tobacco use was associated with lower PCS (p=0.006, Wald chi-square).

Conclusions: The results from these secondary analyses suggest that lifestyle can greatly influence self-perceived health. It is already well-established that tobacco users are at higher risk of periodontal disease, and those who are employed are more likely to have dental insurance. Thus, it is important that dental medicine focus on risk factors associated with poor quality of life, as these same risk factors are associated with oral disease.

(61) The Intersection of Prenatal Oral Health Care Utilization and Dental Education: Results and Policy Implications

Puett SJ[1], Phillips C[2], Tellez M[3], Byrd MG[4] , Boggess K [5], Quinonez RB[4]

[1]DDS Student, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [2] Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [3] pOHP Coordinator, University of North Carolina at Chapel Hill, Chapel Hill, NC, [4]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [5]Obstetrics and Gynecology, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, NC

Objectives: To evaluate the characteristics of pregnant women served through the University of North Carolina's (UNC) prenatal oral health program (pOHP) dental clinic.

Methods: A retrospective chart audit captured 264 pregnant women who made appointments from 2015-2019. Descriptive statistics and bivariate analyses were computed to assess factors associated with dental appointment attendance and treatment completion.

Results: Women receiving care had a mean age of 30 years and mean gestational age of 24 weeks at the time of their first scheduled appointment. Women were referred from 12 distinct community sites. Nearly half of women (46%) were enrolled in Medicaid and 58% indicated English as their primary language. Of the 264 women referred and appointed, 81% (N= 213) attended at least one appointment. The most common procedures were diagnostic (oral evaluations and radiologic exams) and preventive, followed by restorative and oral surgery. Only 12% (N=32) of women completed the recommended treatment plan prior to their estimated due date (EDD). Nineteen percent (N=50) of women returned after delivery to resume dental care. Women re-entered dental care at a median of 67 days (mean=151 days) after their EDD and completed treatment at a median of 378 days (mean=403 days) following delivery.

Conclusion: Academic settings can provide a safety net for pregnant women's oral health. With one in ten women completing recommended dental care prior to delivery and fewer following birth, much remains to be done to ascertain comprehensive oral health for this population. The lag time between delivery, women re-entering the dental system, and care completion is inconsistent with the national Medicaid policy, posing a challenge for this underserved population to establish a state of oral health.

(62) Preparedness Level of Middle and High School Athletic Trainers in the State of North Carolina in Immediately Managing Dental and Orofacial Injuries

Companioni S[1], Groody J[1], Duqum I[2]

[1]DDS Candidate 2020, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: According to the 2017-2018 High School Athletics Participation Survey conducted by the National Federation of State High School Associations, 7,980,886 high school students are participating in athletics. Although participation in high school sports provides healthy benefits to athletes, it puts them at risk for injuries, including dental and orofacial trauma. In the event of injury during a high school athletic event, the athletic trainer is typically the first to respond and manage all injuries. However, the preparedness of athletic trainers to manage dental and orofacial trauma has not been validated in previous studies. The aim of this study was to determine the knowledge and preparedness of middle and high school athletic trainers in treating a dental or orofacial injury.

Methods: Middle and high school athletic trainers in North Carolina were contacted with an electronic questionnaire by e-mail using the Qualtrics secure web application. Informed consent and a completed questionnaire were required to be included in the study. Descriptive statistics were used to analyze the data.

Results: 51 athletic trainers across North Carolina completed the survey, of which 76.47 % received professional training to manage dental and orofacial trauma through various forms. Preparedness level ranged from 50.98 % to 98.03 %, depending on the type of injury. Confidence level ranged from very confident to very non-confident. Of participants, 45.83% did not feel they had the resources necessary to handle a dental injury and 43.13% did not feel they had the resources necessary to handle a complex orofacial injury. 86% of middle and high school teams were not associated with a team dentist.

Conclusion: Based on the results of the survey, the preparedness of middle and high school athletic trainers varies greatly. Standardization and improvement of education is pertinent to the prevention and treatment of trauma in the athletic population.

Funding: Dental Foundation of North Carolina

(63) Overweight/obesity and Dental Caries among Preschool-age Children in North Carolina

Davis MP[1], Ginnis J[1], Wu D[2], Shrestha P[1,3], Divaris K[1,3]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objectives: Reports on the association between overweight/obesity (OWOB) and early childhood caries (ECC) have thus far been inconclusive. Here, we sought to study the prevalence and co-morbidity of OWOB and ECC at the community level, and explore postulated common risk factors.

Methods: We used data obtained in an epidemiologic study of early childhood oral health in children ages 3-5 attending public preschools in NC. Caries diagnoses were based on ICDAS criteria. Anthropometric measurements were based on age- and gender-adjusted body mass index (BMI) CDC-referenced Z-scores. We used bivariate testing methods (i.e., chi-square and ANOVA with Tukey-corrected $P<0.05$ criterion) to investigate the correlation of dental caries measures with OWOB, and their associations with demographic and behavioral characteristics (i.e., race/ethnicity, parental education, diet).

Results: Among 6,355 children with complete dental and anthropometric information, 54% had ECC (defined at the ICDAS>2 level), 36% had untreated disease, and 23% had OWOB. We found no association between OWOB and ECC; however, the number of decayed (i.e., untreated) tooth surfaces was weakly, inversely correlated with BMI Z-scores (ANOVA $P=0.005$, $R^2=0.7\%$). Frequent consumption of sugar-containing snacks and beverages was strongly associated with all caries measures but not with OWOB/BMI. Hispanics had the highest prevalence of both OWOB (35%) and ECC (61%), and parental education was strongly negatively associated ($P<0.0005$) with both conditions.

Conclusion: ECC and OWOB were not significantly associated; yet, we found evidence of common demographic and social determinants underlying both. Future investigations should help clarify the specific social, behavioral or biological pathways underlying these observations.

Funding: NIH/NIDCR U01-DE025046

(64) Derivation and Description of Clinical Subtypes of Early Childhood Caries

Simancas-Pallares MA[1,2], Shrestha P[2,3], Spangler HD[4], Ginnis J[2], Ferreira Zandona AG[5], Vann WF Jr[2], Karhade DS[2], Divaris K[2,3]

[1]Division of Oral & Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, [4]Adams School of Dentistry, University of North Carolina at Chapel Hill, [5]Department of Comprehensive Care, School of Dental Medicine, Tufts University.

Objective: Early childhood caries (ECC) is the most common chronic childhood disease. An internationally harmonized, consensus definition of ECC now exists; however, the diversity of clinical presentations within the ECC definition presents challenges for its precise diagnosis and optimal management. In this study, we sought to identify clinical subtypes of ECC in preschool-age children.

Methods: We used ICDAS surface-level information on dental caries experience from a community-based sample of 3-5-year-old children [N=6,404 of which 54% (n=3,465) had ECC] participating in an epidemiologic study of early childhood oral health in North Carolina, United States. Tooth surfaces were treated as latent class indicators and responses were dichotomized according to caries experience (ICDAS>2 threshold). Latent class analysis (LCA) was carried out to identify clinical disease subtypes (i.e., latent classes). The model with optimal number of classes was determined using a combination of criteria including information-heuristic measures of relative fit (i.e., Akaike and Bayesian Information Criterion, Lo-Mendell/Vuong-Lo-Mendell Rubin and Bootstrap Likelihood Ratio Tests), and clinical relevance. The LCA was done first in the entire sample and then stratified according to dental treatment status (i.e., restored vs. non-restored disease). We used Mplus v.8.3 (Muthén & Muthén, Los Angeles, USA) for all analyses.

Results: We identified five distinct and clinically relevant ECC subtypes within the entire sample, with class membership probabilities ranging from 48% to 8%. The subtypes segregated according to combinations of recognizable patterns of caries lesion distribution, e.g., affected maxillary anteriors, molars, both molars and maxillary incisors. Dental treatment-stratified analyses identified 5 classes for the group that had received restorative treatment and 4 for the unrestored disease group.

Conclusions: The identified clinical subtypes of ECC are important as they offer an additional framework to -under the paradigm of precision oral health- childhood dental disease. Upon validation, this classification can further inform ECC diagnosis, risk assessment and disease management.

Funding Source: NIH/NIDCR - U01DE025046.

(65) Spatial Analysis of Unrestored Early Childhood Caries in North Carolina

Shrestha P[1,2], Byrd GL[1], Davis MP[1], Ginnis J[1], Meyer BD[1], Simancas-Pallares M[1], Divaris K[1,2]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objectives: The influence of social determinants of health and upstream or community factors on oral health and disease is well-established. Untreated dental disease in children is an important problem from clinical, public health and policy standpoints—however, empirical evidence on its spatial distribution and community-level determinants is scant. To address this knowledge gap, we sought to characterize the spatial distribution of unrestored early childhood caries (ECC) in a large, community-based sample of preschool-age children in North Carolina (NC).

Methods: We used tooth surface-level clinical data of caries experience from 6,404 preschool-age children (mean age=52 months; range=36-71 months) who were participants of the ZOE 2.0 study in NC. Clinical examinations were done by trained and calibrated examiners in community locations using ICDAS criteria. We defined ECC at the 'moderate' clinical presentation threshold (ICDAS>2). We used a geographic information systems (GIS) analysis approach to determine the spatial distribution and clustering of unrestored ECC across NC. We used Getis-Ord Gi* statistic to conduct 'hot spot' analyses and the Anselin local Moran's I measure to identify within-cluster positive and negative outliers. Analyses were done using ArcGIS Pro 2.2 software.

Results: The prevalence of untreated decay in the study population was 36% (n=2,259), two-thirds of all ECC cases. We found evidence of spatial heterogeneity and identified 4 clusters of high and 1 cluster of low density of unrestored disease at the 99% confidence level, whereas these figures were 6 and 1, respectively, at the 95% confidence level. Local

Moran's I analysis revealed several positive (i.e., good/poor oral health in a high/low disease density area) and negative outliers within these clusters.

Conclusions: Understanding of the spatial distribution of oral disease experience and specifically unmet restorative treatment needs can provide valuable insights and directions for the development of state-wide programs for oral health promotion and disease treatment.

Funding: NIH/NIDCR: U01DE025046

(66) Development of a Novel Imputation Method for Missing Fluoride Measurements in a Community-Based Epidemiologic Study

Gu Y[1], Shah M[2], Shrestha P[2,3], Simancas-Pallares M[2], Karhade DS[2], Ginnis J[2], Divaris K[2,3].

[1]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objectives: Direct measurements of domestic water fluoride content provide valuable information regarding individuals' fluoride exposure; however, they are rare and logistically challenging to carry out at a large scale. Here we present the development and evaluation of a novel method for the imputation of missing domestic water fluoride concentration data informed by spatial autocorrelation.

Methods: We used domestic water fluoride concentration data that were generated in ZOE 2.0, an epidemiologic study of early childhood oral health in NC. Fluoride concentration was measured with the EPA 300.0 method in domestic water samples that were available for approximately 25% of study participants. Residential locations were geocoded using ArcGIS Pro 2.2 software. Additional information used included questionnaire responses on home water source and clinical data on children's dental caries status [early childhood caries (ECC) case status]. We initially considered 3 existing interpolation methods including inverse distance weighting (IDW), universal kriging (UK), and k-nearest neighbors (KNN). The new method (PAMRF) was based on a combination of partitioning around medoids (PAM) clustering and Random Forest classification.

Results: A leave-one-out cross-validation (LOOCV) suggested that, based on error rates, PAMRF outperforms the other 3 methods. One-third of the 4,779 missing fluoride values were imputed with PAMRF with ≥95% confidence. The estimate of association between optimal fluoride concentration (≥0.60 ppm) and ECC remained virtually unchanged between analyses of observed and observed plus all imputed data, but there were large gains in precision: observed (n=1,360)—prevalence ratio (PR)=0.86 [95% confidence interval (CI)=0.77-0.95], $P=2x10^{-3}$ *vs*. observed and all imputed (n=5,761)—PR=0.86 (95% CI=0.83-0.91), $P=1x10^{-10}$.

Conclusion: We have developed a powerful method for imputing missing fluoride values that outperforms existing approaches. Investigators can use PAMRF to select different sets of imputed values according to tuning parameters, allowable error rates or target sample size, depending on the requirements of their application.

Funding: NIH/NIDCR U01-DE025046

(67) Over-the-counter Medication Use in a Community-based Sample of Preschool-age Children.

Ni RS[1], Jones K[1], Simancas-Pallares MA[1], Shrestha P[1,2], Karhade DS[1], Ginnis J[1], Slade GD[1], Divaris K[1,2]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objectives: Over-the-counter medications (OTCM) can be beneficial when used as indicated, but they might be used inappropriately as a substitute for needed dental care. Here, we examine the prevalence, types and correlates of OTCM reported by a community-based sample of preschool-age children who were participants of an epidemiologic study of early childhood oral health.

Methods: We used questionnaire and examination information obtained from 8,059 preschool-age children (mean age=53 months) enrolled in Head Start centers in North Carolina and participating in the ZOE 2.0 study. In the questionnaire, parents were asked whether their child had received any OTCM within the last 30 days, and if so, to specify the medication(s). Responses were categorized into common medication groups. Children's dental caries status was determined by trained and calibrated examiners using International Caries Detection and Assessment System (ICDAS) criteria. Early childhood caries (ECC) was defined as ≥1 tooth surfaces with restored or untreated caries lesions defined at the threshold of ICDAS>2. Data were analyzed using descriptive statistics and bivariate (Chi-square) tests of association.

Results: Eighteen percent (n=1,470) of children used OTCM in the preceding 30 days, with 16% (n=1,304) using one or more of the five most frequent groups: analgesic (5%), cold and cough medication (5%), allergy medication (5%), anti-inflammatory (4%), vitamins/supplements (1%). Among those, most children had received one (79%) or two (18% medications). Non-Hispanic whites were twice as likely (26%) to report receipt of OTCM compared to their African American (13%) and Hispanic (12%) counterparts (P<0.0005). This difference was most pronounced for analgesics and anti-inflammatories. A majority of children had ECC (54%) and one third had untreated caries (36%), although neither condition was meaningfully associated with use of any OTCM groups.

Conclusion: While ECC was highly prevalence in this cohort, there was no evidence of recourse to OTCM to manage it.

Funding: NIH/NIDCR U01-DE025046

(68) A Qualitative Interprofessional Approach to Older Adult Outpatient Clinical Care

Dsouza RM[1], Robinson JM[2], Johnson HS[3], Rosenberg B[4], Roberts E[4]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Bill Gatton College of Pharmacy, East Tennessee State University, [3]Senior CommUnity Care of North Carolina, PACE Center, [4]Center for Aging and Health, Division of Geriatric Medicine, School of Medicine, University of North Carolina at Chapel Hill

Objectives: The projected demographic rise in the proportion of older adults (≥65 years old) will necessitate changes in the delivery of outpatient medical and dental clinical services in order to enhance quality and accessibility of older adult care. The objective of the study was to provide recommendations for optimal outpatient clinical older adult care through learning from the experiences of older adults and caregivers who access outpatient medical and dental clinical services and of providers in a variety of outpatient clinical settings through a qualitative approach.

Methods: Fifteen interviews of providers of outpatient clinical services from disciplines including dentistry, medicine, nursing, physical therapy, occupational therapy, pharmacy, and social work were conducted. Additionally, two focus groups were conducted with a total of 19 older adults and caregivers from community senior centers. Interview and focus group transcripts were analyzed using the Sort and Sift, Think and Shift thematic analysis approach.

Results: Hindering factors to optimal outpatient clinical medical and dental care discussed by both providers and older adults/caregivers included: lack of affordability, poor interprofessional collaboration/coordination of services, older adult impairments (sensory, physical, and cognitive), poor health literacy, and ageism. Supporting factors discussed by both providers and older adults/caregivers included: caregiver and advocate support, clinical characteristics for patient safety and comfort, and clinical processes and procedures regarding provider-patient communication and follow-up.

Conclusion: Guidelines are needed that are representative of all medical and dental outpatient clinical settings and should address factors such as advocate support, unique needs of older adults, provision of community resources, and coordination of services between disciplines that provide outpatient care. Future studies should incorporate the international guidelines from the World Health Organization (2008) Age-Friendly Primary Health Care Centres Toolkit and specifically investigate ways to integrate the guidelines for older adult dental care.

Funding: Carolina Geriatrics Workforce Enhancement Program (CGWEP); Health Resources and Service Administration (HRSA), Department of Health and Human Services; Center for Aging and Health, Division of Geriatric Medicine; School of Medicine, University of North Carolina at Chapel Hill.

(69) Biofilm Metagenomics and Metatranscriptomics in Early Childhood Caries

Cho H[1], Tang B[2], Roach J[3], Ribeiro AA[4], Wu D[1,5], Divaris K[6,7]

[1]Department of Biostatistics, University of North Carolina-Chapel Hill, [2]Department of Statistics, University of Connecticut, [3]Research Computing, University of North Carolina-Chapel Hill, [4]Division of Diagnostic Sciences, University of North Carolina-Chapel Hill, [5]Division of Comprehensive Oral Health, University of North Carolina-Chapel Hill, [6]Division of Pediatric and Public Health, University of North Carolina-Chapel Hill, [7]Department of Epidemiology, University of North Carolina-Chapel Hill

Objectives: Early childhood caries (ECC) is a dysbiotic oral disease that affects over a fifth of preschool-age children in the US. The results of the disease manifest on individual tooth surfaces, but the disease itself is best understood and characterized via the supragingival microbiome composition, activity and metabolism. High-throughput sequencing technologies have enabled comprehensive insights into metagenomics and metatranscriptomics of the supragingival microbiome. Our overarching goal is to identify microbial species and genes implicated in ECC.

Methods: We used whole genome sequencing shotgun (WGS) and RNA-seq. data generated from supragingival biofilm samples of 420 children aged 3 to 5, enrolled in a community-based genetic epidemiologic study of early childhood oral health in North Carolina (ZOE-pilot and ZOE 2.0). Participants' clinical ECC diagnoses were based upon visual, ICDAS criteria. To handle zero-inflated dispersed counts and composite sequence data, we conducted simulations to compare Type I errors and power of existing statistical methods for differential gene expression. To jointly analyze metagenomics and metatranscriptomics, we developed a new strategy to model the RNA/DNA ratio, as a measure of differential bacterial transcriptional activity (i.e., expression relative to abundance). For each gene-species in each sample, RNA/DNA ratios are grouped into four

categories based on DNA and RNA being zero or nonzero. This new method is implemented in R statistical language and applied to the ZOE study data.

Results: The Logistic Beta test had the highest power and maintained Type I error in simulations, and thus was used to identify ECC-associated species and genes. The RNA/DNA ratio is a mixture of well-defined distributions and the proposed integrative method is suitable.

Conclusion: Our simulated and real-data applied work offer insights into optimal modeling approaches for microbial 'omics data analyses, including integrative metagenomics and metatranscriptomics. Ultimately, such analyses can illuminate taxonomic and functional aspects of the ECC-associated microbiome.

Funding: NIH/NIDCR U01-DE025046 and R03-DE028983

(70) Developing a Business Model to Implement Childhood Oral Care into General Dentistry Practices

Hess MC[1], Saemundsson SR[1], Quinonez RB[2], Staats BR[3]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Office of Academic Affairs, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Department of Operations, Kenan-Flagler Business School, University of North Carolina at Chapel Hill

Objectives: Pediatric dental clinics are specifically equipped for and focused on the care of young children. General practitioners should also be able to provide most oral health well-care in early childhood; however, the financial viability of implementing an infant oral health program in general practice has not been demonstrated. To address this knowledge gap, we developed a business model to aid in the decision-making of implementing a childhood oral health program in general dental practice.

Methods: We followed a systematic information gathering and expert consensus-building approach to construct a business model template that general dentists can use to input their individual practice and financial parameters. We used expert opinion (i.e., consensus by an experts' panel, n=4) and evidence from the literature to build and inform the model. We validated parameter values via a survey among general dentists in the Northeast US. Model inputs are randomized within constraints based on percentiles identified in the survey and probabilities of possible outcomes are modeled via Monte Carlo simulations. Sensitivity analyses were conducted to determine the influence of changes in the input parameters.

Results: The experts' panel identified 10 parameters (e.g., average patient retention rate, patients' insurance profile, annual income, etc.) that would be most influential on the proposed model. Mean values obtained from the survey and literature for key parameters include annual patient retention rate=79%; case acceptance rate=77%; actual recall interval=6.3 months; net annual income=$190,440; 8.0% of patients with Medicaid insurance. Using these input values, we found that implementation of childhood oral care into a general dentistry office can be financially beneficial, and that some inputs affect the bottom line more than others.

Conclusion: The model and practice parameters offered here can be used to inform decisions regarding the financially viable implementation of early childhood oral health care programs in general dental practices.

(71) Metabolomics Insights in Early Childhood Caries

Heimisdottir LH[1], Cho H[2], Ginnis J[1], Simancas-Pallares MA[1], Ferreira Zandona AG[3], Shungin D[4,5], Wu D[2,6], Divaris K[1,7]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, NC, United States, [2]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, NC, United States,[3]Department of Comprehensive Care, School of Dental Medicine, Tufts University, Boston, MA, United States, [4]Broad Institute of the Massachusetts Institute of Technology and Harvard University, Boston, MA, United States, [5]Department of Odontology, Umea University, Umea, Sweden, [6]Division of Comprehensive Oral Health, School of Dentistry, University of North Carolina at Chapel Hill, NC, United States, [7]Department of Epidemiology, Gillings School of Public Health, University of North Carolina at Chapel Hill, NC, United States

Objectives: Dental caries is defined by a dysbiotic shift at the biofilm-tooth surface interface that if sustained or unaltered, can lead to tooth surface demineralization and caries lesion development. Recent advances in molecular methods have revealed a previously unobservable microbial diversity in the composition of the supragingival biofilm. However, functional characterizations of the biofilm in statuses of health and disease are scant. In this study, we used metabolomics to determine biochemical activity characteristics of the supragingival biofilm that are associated with early childhood caries (ECC).

Methods: The study sample comprised 300 children ages 3-5 (50% with ECC) who attended Head Start centers in North Carolina and were participants in the ZOE 2.0 study. Clinical examinations were conducted by trained and calibrated examiners in community locations using ICDAS criteria. Supragingival plaque samples were collected with sterile toothpicks and immediately frozen until analyses. Metabolomics analyses were based upon Ultra Performance Liquid Chromatography-tandem Mass Spectrometry (UPLC-MS/MS) and included an array of quality control steps and checks. Biochemical compounds were identified by comparison to library entries of purified standards or recurrent unknown entities, using retention time/index, mass-to-charge ratio, and chromatographic data-based criteria by Metabolon®. ANOVA contrasts, Welch's two-sample t-tests and Spearman correlations of log-transformed values were used to identify biochemicals that differed significantly between ECC and health.

Results: We detected 503 named biochemicals in the supragingival plaque samples. We found several differences of biological significance. Overall, amino acids, nucleotides, and their catabolites were more abundant in ECC. Peptidoglycan biogenesis-related metabolites including alanyl-glutamyl-meso-diaminopimelate and bacteria-derived amino acid derivatives such as imidazole propionate and imidazole lactate were also elevated in the ECC group.

Conclusion: Metabolomics analyses are feasible and informative in the context of ECC—gained insights can illuminate key processes and compounds in the biofilm that may help clarify the biological basis of ECC.

Funding: NIH/NIDCR U01-DE025046

(72) Complex Periodontal Phenotype: GWAS Meta-Analysis of Clinical Periodontal Measures in Homogenous Subgroups

Moss KL[1], Divaris K[2], Philips KH[1], Morelli T[1], Beck JD[1]

[1]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Many GWAS studies of periodontal disease use simple phenotypes and employ large, heterogenous populations. Our objective was to conduct a GWAS study using a complex phenotype of periodontal disease in a well-characterized, homogenous population.

Methods: Periodontal disease (PD) measured by PPC-Stages, which has seven mutually exclusive, homogenous subgroups. GWAS analysis of European Americans (EA) and African Americans (AA) in the Atherosclerosis Risk in Communities Study (ARIC) discovered significant hits for Extent of Interproximal CAL≥3mm, Bleeding on Probing, Gingival Inflammation, Pocket depth ≥4mm, plaque, and Number of Missing Teeth. Pleiotropic approach using multiple clinical phenotypes in a single analysis was stratified by PPC-Stages and Z-score transformed in order to conduct Meta-analysis using METAL. GWAS was adjusted for age, sex, center, 10 ancestry PC's. We only considered SNPs with minor allele frequency >0.05 and p-values $<5.0\times10^{-8}$. SNPs were pruned using LD Pruning to produce one SNP per Loci. Loci were replicated within 1mb in the AA cohort.

Results: The number of replicated significant Loci within each PPC-Stage were: I - Healthy=1; II Mild Disease=28; III- Moderate/Posterior Disease=71; IV- Severe=160; V-Mild Tooth Loss/High GI=84; VI-Moderate Tooth Loss=129; VII-Severe Tooth Loss=149. In addition, SNPs in each stage were unique to that stage. We then used Ingenuity Pathway Analysis to determine the top gene networks for each PPC-Stage using the replicated EA+AA datasets. Most PPC-Stages had unique networks. Networks seen (e.g., lipid metabolism, endocrine system disorders, cancer, cardiovascular disease) suggest common pathways between periodontal disease and systemic diseases.

Conclusions: Homogenous groups increase power for GWAS studies. Complex diseases require a more informed phenotype (multiple measures of disease), which results in more significant polymorphism hits. Polymorphisms were validated in the AA dataset and there were multiple significant polymorphisms found within each PPC-Stage. There appear to be common pathways with other systemic diseases and conditions.

(73) Impact of Treatment Expectation on Placebo Response and Analgesic Efficacy in a Randomized Controlled Trial

Sanders AE[1], Slade GD[1], Fillingim RB[2], Ohrbach R[3], Arbes SJ Jr[4], Tchivileva IE[5].

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2] Department of Community Dentistry & Behavioral Science, University of Florida, Gainesville, FL, [3] Department of Oral and Maxillofacial Surgery, University at Buffalo, State University of New York, Buffalo, NY, [4]Rho Inc, Durham, NC, [5]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objective: Novel and approved analgesics are failing to show efficacy in recent randomized controlled trials (RCT). Underpinning this failure is an increasing placebo response, driven by patients' heightened expectation of treatment benefit. We hypothesized that heightened expectations of pain relief differentially amplify placebo analgesia, leading to an underestimation of the treatment effect.

Methods: SOPPRANO (Study of Orofacial Pain and PropRANOlol) is a double-blind, placebo-controlled, parallel-group, phase 2b RCT that enrolled 200 adults with examiner-verified temporomandibular disorder myalgia at three U.S. study sites. Participants were

randomized 1:1 to propranolol hydrochloride (60 mg, BID) or placebo for nine weeks. Facial pain relief was assessed as the proportion of participants with ≥30% reduction in mean pain index (facial pain intensity multiplied by duration). Efficacy was further quantified as number-needed-to-treat (NNT). Treatment expectation of pain relief was determined at baseline. We tested whether treatment expectation modified the analgesic efficacy of propranolol using a log binomial generalized estimating equation regression model.

Results: Among participants with low expectation of pain relief (40.4%), treatment responders comprised 73.5% in the propranolol arm and 42.7% in the placebo arm. This difference (P=0.007) corresponded to an NNT of 3.2. In the high expectation stratum, treatment responders comprised 67.0% and 63.6% in the propranolol and placebo arms, respectively. The heightened response in the placebo group markedly diminished efficacy (NNT= 29.6). The test for interaction (P=0.068) represented credible effect modification. Propranolol was superior to placebo where participants' treatment expectations were modest. Where expectations were heightened, placebo analgesia rendered propranolol efficacy negligible. The trend of increasing placebo response is limited to studies conducted in the U.S. One explanation is that treatment expectations are influenced through direct-to-consumer advertising of prescription drugs, legalized in the U.S. and New Zealand, but not elsewhere.

Conclusion: Increasing placebo response has wide-ranging implications for drug discovery, physician decision-making, and public health.

Funding: Funding for this study was provided by the National Institutes of Health (NIH)/National Institute of Dental and Cranial Research (NIDCR) R34-DE022088 and U01-DE024169 grants. The trial is registered at ClinicalTrials.gov, number NCT02437383.

Social Science

(74) Understanding Factors Influencing Young Orthodontist Career Decisions

Campbell CB[1], Mihas P[2], Lin FC[3], Ko CC[1], Jacox LA[1]

[1]Divison of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Howard W. Odum Institute for Research in Social Science, Davis Library, University of North Carolina at Chapel Hill, [3]Department of Biostatistics, Translational and Clinical Sciences Institute, University of North Carolina at Chapel Hill

Objectives: Recent orthodontic graduates have changed their career trajectories. Less than one-third pursue ownership today, compared to 62% in 2010. We aimed to understand the impact of early career choices on long-term earning potential and job satisfaction.

Methods: To understand this shift, we conducted semi-structured interviews, and distributed a national survey to AAO members as part of a sequential mixed methodology study.

Results: Co-occurrence data gathered from qualitative interviews identified income security (49), work-life balance (43), and geography (40) as key influencers. However, autonomy (55), through ownership, remains an important goal, with graduates delaying practice purchase and peak earnings to establish themselves financially and personally.

Conclusion: We posit our national survey of AAO members will yield corroborating results when evaluated through descriptive and bivariate analyses. This survey addresses the effects of marketplace competition and educational debt on young orthodontists.

Funding: American Association of Orthodontists Foundation (AAOF), Southern Association of Orthodontists (SAO)

(75) Stress and Coping among Predoctoral and Advanced Dental Education Students/Residents

Worthington PM[1], Phillips C[2], Bennett ME[1]

[1]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Office of Academic Affairs, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Recent reports in both academic literature and popular media of mental distress in healthcare providers have raised questions about the climate of wellness in professional education programs. The aim of this study was to assess the contribution of demographic and social support variables on the perception of wellness among predoctoral (PD) and advanced dental education (ADE) students at one US Dental School. Of particular interest was the difference in perceived mental wellness between the PD and ADE populations given the inherent differences in age and time spent in training.

Methods: An online questionnaire was distributed to 455 PD and ADE students. The survey included demographic queries, screening for depression (PHQ-9), anxiety (GAD-7), and provider burnout (Maslach Burnout Inventory), as well as a modified version of the Medical Outcomes Study Social Support Survey.

Results: The response rate was 64% for PD (N=211) and 66% for ADE (N=53). Overall PD students showed higher self-reported levels of moderate to severe anxiety and depression than ADE students, but the difference was not statistically significant. A total of 16 students reported an incidence of suicidal ideation within the last 12 months, with a greater, but not statistically significant difference, prevalence among the ADE population. The survey found low overall levels of professional burnout, and the reported difference between PD and ADE was not statistically different despite increased years in training and a greater reported student debt load. A higher reported level of loneliness was associated with increased anxiety, depression and emotional exhaustion across all student populations. Specifically, the ADE population reported significantly less positive social interaction and emotional support.

Conclusion: A focus on activities to increase meaningful personal interaction amongst ADE students outside of the school setting may be warranted to increase emotional resilience.

Funding: Office of Academic Affairs, Adams School of Dentistry, University of North Carolina at Chapel Hill

(76) Influences on Dentists' Adoption of Non-Surgical Caries Management Techniques for Children

Crisp J[1], Mihas P[2], Wright JT[1], Divaris K[1,3], Sanders AE[1]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Odum Institute for Research in Social Science, University of North Carolina at Chapel Hill, [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill.

Objectives: The adoption of non-surgical caries management techniques (NSCMT) (e.g. silver diamine fluoride, Hall Crown, fluoride varnish) by the dental community is arguably slow and varied. To understand this phenomenon, we undertook this study seeking to understand the influences on NSCMT adoption amongst NC dentists who primarily treat children.

Methods: From September 2018 to January 2019, we recruited 14 NC pediatric dentists and 6 general dentists who primarily treat children via a snowball sampling method, stratified by years in practice, geographic location, and private vs. public health practice. Interviews were conducted in person and via telephone using a semi-structured interview guide that was pilot

tested and iteratively revised. Interviews were recorded digitally, transcribed *verbatim* and thematically analyzed with MAXQDA software using an inductive content analysis method that included deductive and inductive coding. Reporting was based on emerging and recurring themes and insightful quotes.

Results: Factors related to clinical practice, family preference, patient safety, and provider philosophy were major influences in the adoption and use of NSCMT. Characteristics of the practice environment and patient population, communication with families, and financial considerations were influential. Barriers to adoption of NSCMT included previous clinical experience, high risk caries population, and perceived likelihood of negative outcomes. Hesitancy to adopt the Hall technique was the most pronounced among older clinicians. Although all respondents were influenced by scientific evidence and professional guidelines, experienced dentists relied more heavily on personal clinical experience compared to more junior ones.

Conclusion: These findings provide valuable insights into practitioners' influences, motivations and clinical decision-making. Specifically, providers often perceived NSCMT as inferior to conventional surgical care in terms of professional reputation building, profitability, acceptability and even clinical efficacy in high-risk populations. Upon validation from additional studies, the identified primary factors and barriers can serve as possible targets of implementation and quality improvement programs.

Funding: MS Research Support Grant, School of Dentistry, University of North Carolina at Chapel Hill

(77) North Carolina Providers' Perspectives on Tooth Autotransplantation for the Replacement of Missing Teeth

Dokova AF[1], Christensen JR[1], Reside GJ[2], Divaris K[1,3], Lee JY[1]

[1]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

Objectives: Tooth autotransplantation has been used for over 50 years with favorable outcomes of 74-100% in the literature, yet it is not a common practice among US practitioners. This investigation aims to study factors influencing the practice and implementation of autotransplantation among North Carolina dentists. Specifically we seek to: 1) determine the extent of pediatric dentists' and orthodontists' autotransplantation-related knowledge, attitudes and practices and 2) characterize perceived barriers of adoption among these providers.

Methods: The study is a mixed methods design composed of a structured survey (phase 1) and semi-structured interviews (phase 2). In phase 1, a convenience sample of orthodontists and pediatric dentists recruited from professional/CE meetings will complete a 17-item survey. The survey instrument was pilot tested in December 2019 (convenience sample of full-time Pediatric Dentistry and Orthodontics faculty members at UNC-Chapel Hill Adams School of Dentistry). The study will rely on descriptive and bivariate analysis methods to identify factors associated with implementation of autotransplantation in clinical practice.

Results: Seven full-time faculty members (2 Orthodontic and 5 Pediatric Dentistry; 6 males and 1 female, mean age = 52 years) completed the pilot survey. Six out of 7 respondents had heard of autotransplantation and were interested in incorporating it in their practice, and all respondents were moderately or very familiar with the technique. The existence of an evidence base supporting clinical outcomes and expectations for esthetic results were extremely important influences for the participants' appreciation of autotransplantation.

Conclusions: Upon completion of the study, we expect that the information gained from the survey and the in-person interviews will help illuminate factors influencing the adoption and implementation of tooth autotransplantation in clinical practice. The academically affiliated practitioners that comprised our pilot sample were knowledgeable about tooth autotransplantation, demonstrating interest and experience with referring, planning and participating in teams that perform it.

(78) Student Wellness in Dental Hygiene Programs

Beck JA[1], Kornegay EC[1], Harmon JB[1], Phillips C[2]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill. [2]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: In professional training, regardless of age, institution or degree, students are rapidly thrown into a new environment with difficult challenges. Coping with these challenges is dependent on one's mental and emotional health. The objective of this study was to assess the mental and emotional well-being among dental hygiene students in two intensive, accelerated programs.

Methods: The Institutional Review Board approved this study (IRB 19-2646). A Qualtrics survey was emailed directly to all dental hygiene students at the University of North Carolina at Chapel Hill (UNC-CH) and Guilford Technical Community College in Jamestown, North Carolina (GTCC). The survey included demographic queries, screening for depression (PHQ-9), anxiety (GAD-7) and a modified version of the Medical Outcomes Study Social Support Survey. Chi-square and Mantel Haenszel statistics were used in the analysis depending on scale of measurement. Significance level was set at 0.05

Results: The response rate was 100% for UNC-CH (N=69) and 99% for GTCC (N =54). There were no statistically significant differences between respondents in respect to demographics or personal lifestyles (all P>0.05) There was a statistically significant difference in the proportion of students reporting moderately-severe or severe anxiety (P = 0.007). 56% at GTCC and 34.8% at UNC-CH indicated high anxiety. There was not a statistically significant difference in depression (P=0.07). Overall, 42.6% reported moderately-severe or severe depression. 7.8% of all respondents reported suicidal ideation in the last 12 months.

Conclusion: The proportion of dental hygiene students enrolled in these intensive, accelerated programs had substantially higher mental and emotional issues than anticipated.

Tissue Repair and Regeneration/Wound Healing

(79) Molecular Characterization of Irreversible Pulpitis

Yousefi B, Fouad AF

Division of Comprehenseive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: An attempt to determine the association of a larger array of key inflammatory proteins of the pulp with precisely measured clinical signs and symptoms of normal pulp, and symptomatic and asymptomatic irreversible pulpitis has never been reported. Identifying these molecular mediators will enhance chair-side diagnostic tools available to the dentist/endodontist. The aim of this study was to correlate the levels of key inflammatory mediators in cariously exposed dental pulp of adults with reversible or irreversible pulpitis, and no apical periodontitis, with a panel of subjective and objective diagnostic clinical findings as well as the status of the pulp upon exposure.

Methods: The dental pulp and peripheral blood of four cases that fit the inclusion/exclusion criteria were sampled. The Luminex technology was used to assess the expression of a panel of 45 inflammatory proteins from peripheral and coronal pulp blood to determine the association of inflammatory mediators with clinical signs and symptoms of reversible or irreversible pulpitis.

Results: Data from three pulpal and three peripheral blood samples were available for analysis. The correlation of levels of the 45 proteins in the inflamed dental pulp and peripheral blood was 0.87. The pulp had significantly higher levels of these proteins collectively than peripheral blood (t-test, p=0.047). The following proteins had correlated at a level of ≥ 0.8 with the duration of pain with cold: MMP-12, MMP-9, RANTES, MIP-2, MCP-1, MMP-2, MMP-1 and P-Selectin. Relatively high correlations (0.5 – 0.75) were also present between these proteins and presenting pain level.

Conclusions: A number of pulpal proteins correlate with some spontaneous and evoked pain parameters. More data is needed to identify potential markers of pulp inflammation.

Funding: Grover C. Hunter Short-Term Research Fellowship, Adams School of Dentistry, University of North Carolina at Chapel Hill

(80) Geographical Variations in Microbiota from Immature Teeth with Necrotic Pulp

Fouad AF[1], Roening C[1], Diogenes A[2], Torabinejad M[3], Hargreaves K[2]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2.] Department of Endodontics, University of Texas Health San Antonio Dentistry, University of Texas Health San Antonio, [3.]Department of Endodontics, Loma Linda University School of Dentistry, Loma Linda University

Objectives: Endodontic infections contain diverse microbiota that may be influenced by geographical location. The purpose of this study was to analyze the microbiota in immature teeth with necrotic pulp from four dental schools that participated in a nationally funded randomized clinical trial on pulp regeneration.

Methods: 116 patients with necrotic pulp in immature teeth were included from Loma Linda University (LLU), University of Texas (UT), University of North Carolina (UNC), and University of Maryland (UM). Patients were randomized into three treatment protocols: Regeneration (1.25% hypochlorite with 17% EDTA irrigation, and 0.1 mg/mL of triple antibiotic paste (TAP)), Revascularization (5% hypochlorite in the first appointment, and 1 g/mL of TAP), and Apexification (5% hypochlorite at two appointments and Ca(OH)2). Samples were collected preoperatively (S0), after irrigation at the first appointment (S1), and after 1-3 weeks of medications (S2). Samples were sequenced at Forsyth Institute (HOMINGS platform) (n=46) and at UNC Microbiome Core Facility (n=51).

Results: The most abundant genera were:

	UNC	UM	UT	LLU
S0	*Fusobacterium*	*Fusobacterium*	*Fusobacterium*	*Sphingomonas*
	Bacteroidaceae_[G-1]	*Porphyromonas*	*Tannerella*	*Fusobacterium*
	Selenomonas	*Prevotella*	*Peptostreptococcaceae _[XI][G-7]*	*Pseudomonas*
S1	*Acinetobacter*	*Enterococcus*	*Acinetobacter*	*Enterococcus*
	Bacteroidaceae_[G-1]	*Fusobacterium*	*Sphingomonas*	*Pseudomonas*
	Fusobacterium	*Klebisella*	*Pseudomonas*	*Sphingomonas*
S2	f-Enterobacteriaceae	*Enterococcus*	*Sphingomonas*	*Sphingomonas*
	Acinetobacter	*Klebisella*	*Acinetobacter*	f-Enterobacteriaceae
	Stenotrophomonas	o-Rhizobiales	*Pseudomonas*	*Enterococcus*

There were significant differences among all sites in alpha diversity except for UT vs. LLU ($p<0.05$). At the different time points, S0 had no significant differences among the sites; S1 had significant difference between UM vs. LLU and UNC; and S2 had significant differences between LLU vs. UNC and UM, and between UNC vs. UM and UT ($p<0.05$).

Conclusion: Site differences existed among the four sites in pre-operative and intra-treatment most abundant microbial taxa and diversity. However, the overall trend was the decrease in abundance of typical endodontic taxa and an increase in resistant taxa following treatment procedures.

Funding: Foundation for Endodontics

(81) Outcome Assessment of Teeth with Necrotic Pulps and Apical Periodontitis Treated with Long-Term Calcium Hydroxide

Ammons CL[1], Best S[2], Karunanayake GA[1] , Saemundsson SR[3], Tawil PZ[1]

[1]Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Private Practice, Dr. Sheldon Best Endodontics Inc., Newfoundland, Canada,[3]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: The aim of this study is to evaluate the effects of long-term calcium hydroxide use through the periapical healing assessment of a cohort case series.

Methods: 242 patients with cases of pulpal necrosis and apical periodontitis were treated with long-term calcium hydroxide using a standardized protocol. Injectable and powdered Ca(OH) 2 was placed in the apical and coronal halves, respectively. Access cavities were closed with a layer of Cavit and sealed with a permanent restoration. All cases were re-evaluated every three months until radiographic healing was observed; then, root canal treatment was completed. Clinical and radiographic evaluations were performed annually. Periapical radiographs were evaluated by two blinded independent and calibrated examiners using the periapical index (PAI) system.

Results: 219 patients completed their treatment with a follow-up rate of 88.3%. The average calcium hydroxide time was 5.4 months with a range of 1 - 43 months. The mean pre-op and post-op PAI scores were 4 and 2, respectively. Overall, by the latest follow-up visit, 88.9% (197/219) were classified as "healed" and 9.7% (22/219) were classified as "diseased". Among the diseased cases, 100% (22/22) had radiolucencies that maintained the same PAI

score. Among the diseased cases, there were eight apical microsurgeries, one extraction, and 13 cases that received no treatment.

Conclusion: Long-term calcium hydroxide use has demonstrated favorable healing effects of endodontically treated teeth.

(82) DNA-Methyltransferase Inhibitors Effect on Gingival Epithelial Barrier Function

Besada N, Fahimipour F, Dunham AR, Barros S

Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: Epigenetic mechanisms have been associated with genes regulation contributing with inflammatory pathways activation in periodontal disease. It has been shown that pathogenic bacteria are capable of dysregulating the epigenetic machinery of their target cells. Considering gingival epithelial cells function as the forefront defense line of periodontal tissues against microbial invasions, in this study we aimed to investigate the potential effects of epi-gallocatechin gallate (EGCG) as DNA methyltransferase (DNMT) inhibitor on epithelial barrier function in response to *Porphyromonas gingivalis* infection of human gingival epithelial cells.

Methods: PrestoBlue® Cell Viability Assay was used to analyze the cytotoxicity of EGCG and determine an optimum inhibitor concentration. Primary human gingival epithelial (HGEp) cells were induced with *P. gingivalis*, strain A7436 (MOI 50) in presence or absence of EGCG. Transepithelial electrical resistance (TEER) was recorded using an EVOM® electrical resistance system at various time points. In addition, DNA methylation and mRNA expression levels were quantified by qPCR using EpiTect Methyl II PCR and TaqMan PCR Assays for *PKP2 and TJP1*.

Results: In comparison to non-infected controls, exposure of HGEp cells to *P. gingivalis* decreased TEER ($p<0.0001$) levels in association with increased cells permeability. Also, DNA methylation assays showed increased methylation levels of the junctional proteins *PKP2* and *TJP1* using non-infected cells as controls ($p<0.0001$). Transcriptome analysis of *PKP2* and TJP1 showed down-regulation ($p<0.005$) of these genes of adhesion function. For infected cells pre-treated by EGCG, the methylation levels of *PKP2* and *TJP1* were reduced and associated mRNA expression significantly increased ($p<0.0001$).

Conclusion: The DNMT inhibitor EGCG, could prevent hypermethylation measured at the promoter regions of *PKP2 and TJP1* in epithelial cells exposed to *P. gingivalis* infection. Epigenetic regulation can affect epithelial barrier function, another important factor in the initiation and progression of periodontal diseases.

Funding: Colgate Palmolive

(83) A Multimodal Analgesic Protocol Moderating Acute Pain Levels After Third Molar Removal, an Exploratory Study

Rubin JM[1], Brown PM[1], Neal T[2], Hannan E[2], Kendell B[2], Reside G[2], Phillips C[3], White RP[2]

[1]University of North Carolina at Chapel Hill, [2]Division of Craniofacial and Surgical Care, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Division of Oral and Craniofacial Health Sciences, Adams School of Dentistry, University of North Carolina at Chapel Hill

Objectives: An IRB-approved prospective study was designed to reduce acute pain levels after 3rd molar removal with a multimodal analgesic protocol. Administration of multiple drugs can have detrimental effects on patients' Health-Related Quality of Life Outcomes (HRQOL) Domains: Lifestyle, Oral Function, and Other Symptoms.

Methods: Study participants fit the American Society of Anesthesiologists risk classification I or II, fell within an age range of 18-35 years, and had at least two mandibular third molars removed. Patients being treated for opioid addiction/abuse were excluded. All enrolled subject-patients consented to and were treated with the multimodal analgesic protocol. Data from the surgery day was completed by both the patient and surgeon. HRQOL data each post-surgery day (PSD) for the past 24 hours was derived from a 14-day diary, validity established by Conrad et al, and recorded by subject-patients. The primary outcome variables on a Likert-type scale were "quite a bit" or "lots" of trouble 4-5/5 and "no" or "little" interference 1-2/5 in each item of the HRQOL domains. Descriptive statistics were used for reporting outcomes.

Results: Diary data was available from 48 of 50 enrolled subjects. Thirty-two (64%) were female and the median age was 22 years (IQR 19y, 26y). Forty-eight percent were Caucasian, 25% Latino, 17% African-American, 8% Asian and 2% other ethnicity. Surgeons' median estimate of degree of difficulty was 9/28 (IQR 5,15). Median surgery time was 32min (IQR 20,40). In the Lifestyle Domain, 29% subject-patients reported interference 4-5/5 with daily routine on PSD one, 27% on PSD two, 17% on PSD three. In the Oral Function Domain, 73% reported interference 4-5/5 with eating foods you want on PSD one, 54% on PSD two, 42% on PSD three. In the Other Symptoms Domain, 44% reported swelling of cheeks 4-5/5 on PSD one, 46% on PSD two, 35% on PSD three. Few subject-patients reported problems with nausea 4-5/5: 8% on PSD one and 5% on PSD two.

Conclusion: This exploratory study of a diverse group of subject-patients suggested that a multimodal analgesic protocol for moderate acute pain after third molar surgery may have improved outcomes in the Lifestyle and Other Symptoms Domains, but not Oral Function outcomes.

Funding: Oral and Maxillofacial Surgery Residents Research fund in the Dental Foundation of NC

(84) Investigation of Regenerative Capacity and Molecular Profile of Craniofacial Muscle

Katz LH[1,2], Lee DE[2], Bareja A[2], White JP[2]

[1]Oral and Craniofacial Biomedicine Curriculum, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Duke Molecular Physiology Institute, Duke University.

Objectives: Limited therapeutic options exist to rebuild functional craniofacial skeletal muscle in individuals suffering from orofacial muscle diseases (craniofacial microsomia, facioscapulohumeral muscular dystrophy), trauma, and oncologic surgical defects. Knowledge on craniofacial muscle regeneration is currently lacking as most studies on muscle regeneration are limited to limb muscles, which have distinct embryological origins compared to craniofacial muscles. The objective of this study is to comprehensively assess differences in regenerative capacity, muscle stem (satellite) cell function, and transcriptional profile between these two muscle groups to identify therapeutic targets for craniofacial muscle regeneration.

Methods: Regenerative capacity was assessed *in vivo* by measuring embryonic myosin heavy chain (eMHC), a marker for regenerating muscle, and cross-sectional area of regenerated masseter (craniofacial) and tibialis anterior (TA)(limb) muscles following injury. To determine satellite cell (SC) function *in vitro,* SCs were isolated from masseter and TA using fluorescence-activated cell sorting (FACS) and proliferative ability was measured by EdU incorporation. To dissect the molecular mechanisms of how SCs from different muscle groups contribute to muscle regeneration, we profiled gene expression of quiescent and activated craniofacial and limb SCs using single-cell RNA sequencing (scRNA-seq).

Results: Regenerating craniofacial muscle expressed eMHC earlier than limb muscle and had larger eMHC area by day 5 post-injury. Additionally, craniofacial muscle was able to regenerate 80% of normal fiber size while limb fibers were at 60% 12 days post-injury. FACS revealed that craniofacial muscle contains double the number of SCs per gram of tissue compared to limb. After 24h in culture, craniofacial SCs were proliferating at a significantly higher rate compared to limb SCs. scRNA-seq revealed that quiescent and activated craniofacial and limb SCs display different gene expression profiles.

Conclusion: Our results show that craniofacial muscle has enhanced regenerative capacity compared to limb muscle. The identification of associated molecular profiles could present potential therapeutic targets for craniofacial muscle regeneration.

Funding: UNC Adams School of Dentistry, Division of Oral and Craniofacial Health Sciences

(85) Hesperidin Compromises In Vitro Osteoclastogenesis Process in RAW 264.7 Cells

de Paiva Gonçalves V[1], Wong SW[2], Spolidorio LC[1], Miguez PA[2]

[1]Departament of Physiology and Pathology, Araraquara School of Dentistry, University of São Paulo State, UNESP, Araraquara, São Paulo, Brazil, [2]Division of Oral and Craniofacial Health Sciences, University of North Carolina, Chapel Hill, North Carolina.

Objectives: The aim of this study was to evaluate how hesperidin (HE) modulates the osteoclastogenesis process in vitro given the evidence of increased bone mass of murine animals subjected to dietary supplementation with HE.

Methods: RAW 264.7 cells were divided into 5 groups: 1- Negative control [no receptor activator of nuclear factor kappa-B ligand (RANKL) treatment], 2- positive control (RANKL), 3- RANKL+HE 1μM, 4- RANKL+HE 100μM, 5- RANKL+HE 500μM. Briefly, the cells were stimulated with 30ng/ml RANKL in the presence or not of various HE concentrations for 5 days. On day 5, osteoclast apoptosis and cell differentiation were assessed, respectively, by TUNEL and tartrate-resistant acid phosphatase (TRAP) staining analyses. Cell samples were harvested for Western Blotting on days 2, 3, 4 and 5 to evaluate caspase 3, c-Fos and Nfatc1 protein expression. ANOVA followed by Tukey post hoc test were used for statistical analyis.

Results: At the end of 5 days the treatment with HE concentrations did not change the average percentage of apoptotic osteoclasts compared to controls. RANKL stimulation induced the osteoclasts differentiation in all treated groups as observed by positive TRAP staining. Significantly reduced formation of RANKL-stimulated TRAP-positive multinucleated cells was observed after treatment with the highest HE concentration (500μM) ($p<0.05$). Western Blotting showed that caspase 3 protein expression remained the same in control negative, RANKL alone and HE-treated groups. RANKL, as expected, induced higher expression of c-Fos and Nfatc1 compared to controls. HE treatment downregulated the c-Fos and Nfatc1 protein expression at every timepoint of the osteoclastogenesis differentiation period already at 100μM.

Conclusions: HE impairs in vitro osteoclastogenesis in RAW 264.7 cells and it seems to involve at least both c-Fos and Nfatc1 downstream of NF-KB pathway. Further experiments are underway to identify if other pathways are involved.

Funding Source: NIH/NIDCR R03-DE028035

(86) Management of Traumatically Luxated Permanent Teeth: A Retrospective Study

Daly IL[1], Koroluk LD[1], Jackson TH[1], Phillips C[2], Christensen JR[2]

[1]Division of Craniofacial and Surgical Care, Orthodontics, Adams School of Dentistry, University of North Carolina at Chapel Hill, [2]Office of Advanced Education, Adams School of Dentistry, University of North Carolina at Chapel Hill, [3]Pediatric Dentistry & Orthodontics, Durham, North Carolina

Objectives: The International Association of Dental Traumatology guidelines state that teeth must be repositioned after luxation injuries, however, the specific method of repositioning has not been specified. The purpose of this study was to compare pulpal and periodontal outcomes of digitally and orthodontically repositioned incisors following extrusive and lateral luxation.

Methods: The study sample was comprised of 80 (32 females, 48 males) subjects with 126 teeth treated for lateral and extrusive luxation injuries. . 41 teeth were orthodontically repositioned, 67 teeth were digitally repositioned and 18 teeth had mixed treatment.

Results: 35.7% of the teeth required follow up endodontic treatment. Follow up treatment was required in 19.5% of the orthodontically repositioned teeth, 40.3% of the digitally repositioned teeth and 55.6% of the mixed treatment teeth. There was a statistically significant difference in the frequency of follow up endodontic treatment between the three groups; the orthodontically repositioned teeth required less intervention (p=0.02).

Conclusion: Luxated teeth treated with orthodontic repositioning appear to require less follow-up endodontic treatment than luxated teeth treated with digital or mixed repositioning.

Acknowledgements

Research Day Organizing Committee
Tony Amelio, Alexis Dolgetta, Colin LaPrade, Sarah Liebkemann, Julie Marchesan, Apoena Ribeiro, Rishma Shah, Shannon Wallet

Abstract Reviewers
Tony Amelio, Julie Marchesan, Apoena Ribeiro, Rishma Shah, Shannon Wallet

Office of Innovation and Discovery
Alexis Dolgetta, Shannon Wallet

Audiovisual Support
Megan Caron, Taarl Morley, Chris Pope

Dental Foundation of North Carolina
Paul Gardner

Support Services
Doug Brockett

AADR Local Chapter Student Research Group
Colin LaPrade, Sarah Liebkemann and the SRG Research Day Support Team members who contributed to the organization and support of the day

NCTraCS
Susan Pusek

UNC Office of Corporate and Foundation Relations
Brooke Church

We would like to thank all students, faculty and staff of the UNC-CH Adams School of Dentistry and other institutions, including East Carolina University, Virginia Commonwealth University and NC State University for their participation and contribution to the 2020 UNC-CH Adams School of Dentistry Research Day.

The **North Carolina Section** of the **American Association for Dental Research** (NC-AADR) is proud to support and coordinate UNC-CH Adams School of Dentistry Research Day

NC-AADR President: Rishma Shah
Past-president: Kimon Divaris
President elect: Julie Marchesan
Secretary: Apoena Ribeiro
Treasurer: Antonio Amelio

Sponsors

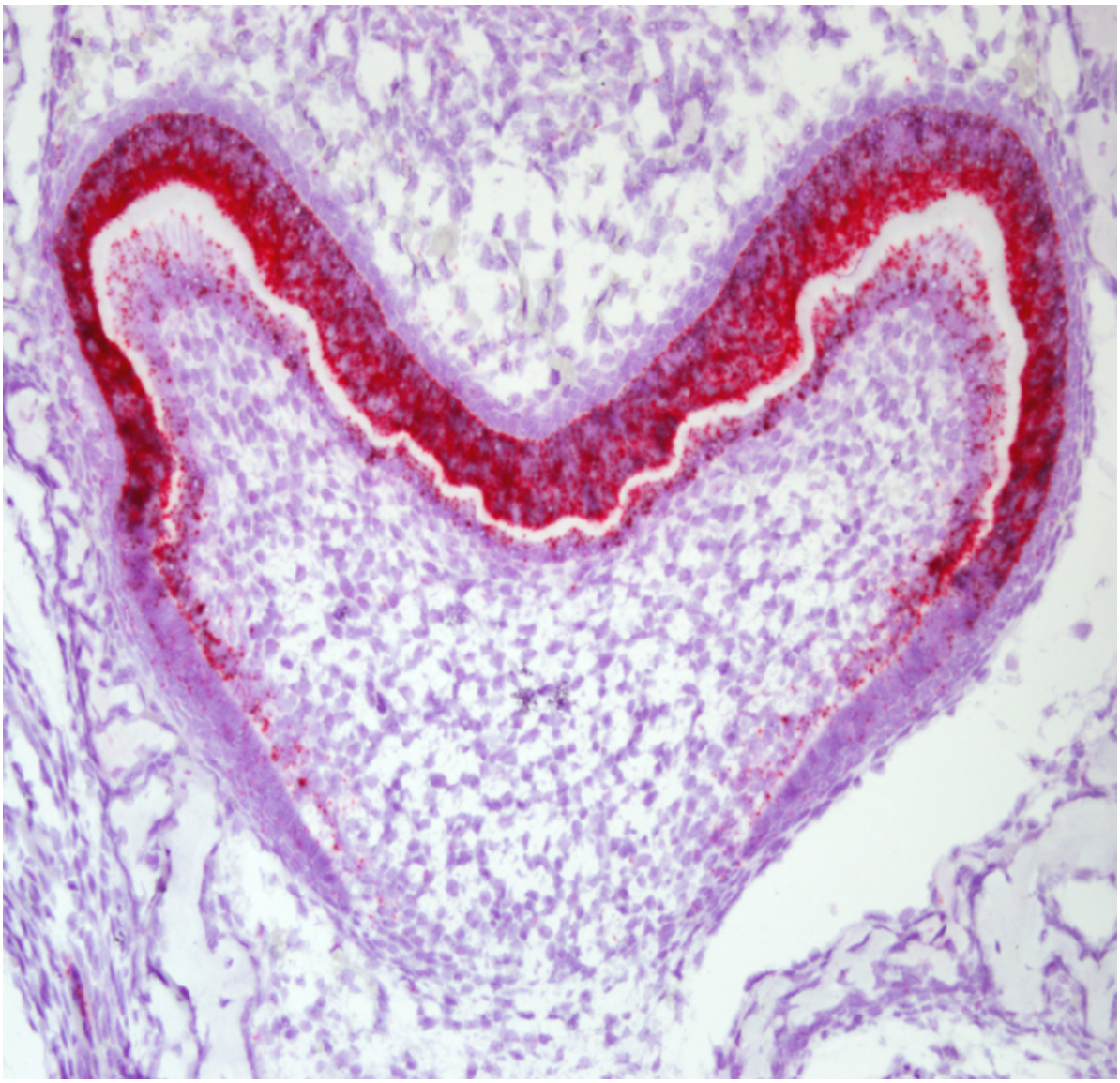
AADR Local Chapter Student Research Group

UNC-CH Adams School of Dentistry Department Chairs – via their NC-AADR membership

Dental Foundation of North Carolina

UNC-CH Adams School of Dentistry Office of the Dean

Notes



Expression pattern of *Wnt10a* during tooth morphogenesis