RESEARCH DAY 2020

STAY HOME EDITION

CONGRATULATIONS

to the Indiana University School of Dentistry Research Day award recipients and participants.

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DELTA DENTAL FOUNDATION

IUSD RESEARCH DAY PROCEEDINGS

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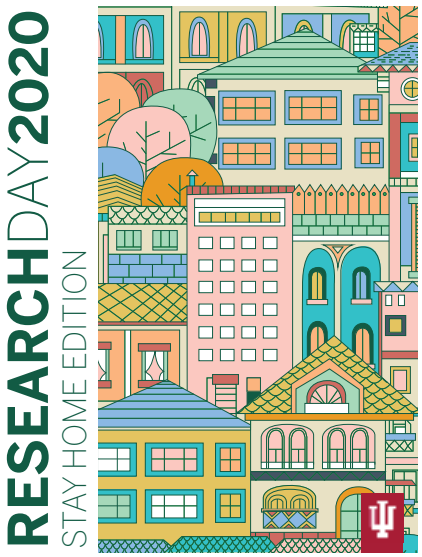

This year, IUSD Research Day, looks very different than it has in the past. Due to extenuating circumstances, COVID-19, working from home has become the modus operandi. This cover is meant to honor the resilience of humanity, of science, and the hard work of all involved, specifically the organizing committee, who have made a virtual Research Day 2020 possible from home, while social distancing.

The show must go on.

Cover design and layout by Nicole Alderson.
Student Research Group photo by Abby Morgan.
Research Day proceedings monograph prepared by Keli Seering.

IUPUI

SCHOOL OF DENTISTRY

OFFICE OF THE DEAN

Indiana University
Indianapolis

April 6, 2020

Indiana University School of Dentistry Colleagues and Friends:

Welcome to the 28th Annual Indiana University School of Dentistry (IUSD) Research Day!

We are most proud of our long-standing tradition of excellence in research and discovery, which serves as the foundation for our clinical care and education missions, as we strive to improve the oral health of the people of the state of Indiana and around the world. Engagement in research and other forms of scholarship enhances the education of our students, and opens up a world of possibilities through the discovery of new knowledge and its dissemination through presentations and publications. For most, it will deepen their understanding of the science foundation of dentistry and enrich their clinical practice. For others, it will ignite a passion for another career path- to impact the world through dental research.

I am very proud of all of our student investigators and their faculty research mentors who are presenting their work today. Our annual Research Day is the day we showcase their science, appreciate the breadth of work and its impact, and celebrate our investigators for their accomplishments and contributions to advance oral health through excellence in research.

Unfortunately, our research day "in-person" event this year needs to be canceled based on the requirements of Indiana University, the Centers for Disease Control and the US Surgeon General, to promote public health and safety through the COVID-19 pandemic. However, we will maintain the essence of Research Day using a modified format this year. The Research Day planning committee has been working to create the online archives for all of the poster presentations to allow students, graduate students, and faculty members publish and view our research activities. Also, the committee is working to conduct judging of posters online, in accordance with current social distancing policies. I believe that this will be an excellent opportunity to learn new ways of doing things using technology!

I want to thank the Research Day planning committee and the Indiana Section of the American Association for Dental Research for planning and presenting today's event. I also want to give a special thanks to our generous event sponsors.

Enjoy!

Carol Anne Murdoch-Kinch

Carol Anne Murdoch-Kinch, DDS, PhD
Dean

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AADR®
American Association for Dental Research

March 18, 2020

Dear Research Day Attendees,

On behalf of the Organizing Committee and the Indiana Section of the American Association for Dental Research (IN-AADR), Reed McKinney and I would like to welcome you to the Indiana University School of Dentistry (IUSD) 28th Annual Research Day.

The Indiana Section is the regional link to the national (AADR) and the international (IADR) associations for dental research. The primary objective of the IN-AADR is to promote and advance basic and clinical research in all areas of the dental sciences, including the oral cavity, its adjacent structures, and the relationship to the body as a whole. Together, by utilization of this knowledge, we hope to advance dental science by developing new and better options for the prevention and treatment of oral diseases, as well as pathologies of the head and neck. Furthermore, these activities intended to foster better communication and cooperation among professionals – from bench researchers to clinicians – in order to share this knowledge for the benefit of all.

Within IUSD, the IN-AADR sponsors or co-sponsors invited speakers from all dental disciplines, in addition to coordinating events for the annual Research Day. By itself, Research Day offers an opportunity for investigators to present and highlight advances in basic and clinical dental research at IUSD both to their peers and in a public forum. Furthermore, Research Day offers a chance for attendees to interact with faculty and student investigators in addition to various sponsors and vendors.

This year, unfortunately, we are not able to have this event due to the COVID-19 situation. Following the guidelines from President McRobbie's message to the entire IU community, we will be canceling the IUSD Research Day event at the IUPUI Campus Center on April 6, 2020. However, we will create the online archives of the posters from all participants and have a judging event to recognize all of your hard work. We have faced many difficulties in changing format and event itself within short time of period. I sincerely appreciate all of your patience and understandings.

At this time, Reed and I would like to thank all members of the Research Day Committee for their hard work and efforts toward this annual tradition at IUSD.

Sincerely yours,

Yusuke Hamada, DDS, MSD
President, Indiana Section of AADR.

Reed McKinney
President, IUSD Student Research Group.

Research Day Organizing Committee

Yusuke Hamada, Chair

Nicole Alderson
Angela Bruzzaniti
Tien-Min Gabriel Chu
Taylor Dietl
Simone Duarte
Ygal Ehrlich
Roxana Fuentes
Richard Gregory
Lisa Maxwell
Reed McKinney
Carol A. Murdoch-Kinch
Sheryl McGinnis
Kamolphob Phasuk
Waldemar Polido
Stuart Schrader
Keli Seering
Sabrina Feitosa Sochacki
Mythily Srinivasan
Yasuyoshi Ueki
Terry Wilson Jr.

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Newsletter Editor: Warren Travis
Faculty Adviser: Angela Bruzzaniti

IUSD STUDENT RESEARCH GROUP 2019-2020

Back Row L-R : Aya Mansour, Taylor Dietl, William Castedo, Richard Gregory (Associate Dean for Graduate Education), Sammy Petterson, Reed McKinney, James Volovik

Middle Row L-R : Niki Gheibi Dehnashi, Stephanie Kawak, Gina Castiblanco Rubio, Angela Bruzzaniti (Director of Dental Student Research), Marcus Levitan, Parand Sorkhdini, Rebecca Shembarger

Front Row L-R : Mauro Tudares, Justina Anigbo, Naif Nabel Abogazalah, Leandro Figueira, Caroline Tonon, Beatriz Panariello

Recognizing Excellence
2020 Awards

Dental Hygiene

Elizabeth A. Hughes Dental Hygiene Case Report Award

Undergraduate Students

IN-AADR Undergraduate Student Award

Predoctoral Dental Students

AADR Student Research Day Award

Cyril S. Carr Research Scholarship

Dean's Award for Research Excellence

Dentsply Sirona/AADR Student Award for Advancing Dental Research and its Application

IDA Student Research Award

IN-AADR D4 Case Report Award

King Saud University Travel Award for Excellence in Preventive Oral Health Care

Research Honors Program Certificate of Achievement

Graduate Dental Students

Delta Dental Award for Innovation in Oral Care Research

King Saud University PhD Student Travel Award

King Saud University Travel Award for Best Clinical Case Report

Maynard K. Hine Award for Excellence in Dental Research

Staff

IN-AADR Research Staff Award

Faculty

IU School of Dentistry Alumni Association Distinguished Faculty Award for Teaching

IU School of Dentistry Alumni Association Distinguished Faculty Award for Research

King Saud University Distinguished Research Faculty Travel Award

IUSD Research Day 2019 Recap

On April 3, 2019, the 27th annual Research Day event at the IUPUI Camps Center featured the presentation "Moving Dentistry towards Evidence-Based Caries Management: The Importance of Research" by keynote speaker Dr. Margherita Fontana from University of Michigan School of Dentistry. The event included 58 poster presentations, 36 clinical case reports and a ceremony to award 20 distinguished faculty, staff, and students.

Dental Hygiene Students

Elizabeth A. Hughes Dental Hygiene Award
Alissa Shinault and **Brianna Lebeda**
Jennifer Sheets and **Katlin Smithey**, Honorable Mention

Undergraduate Students

IN-AADR Undergraduate Student Award
Lauren Hardebeck

Predoctoral Dental Students

Cyril S. Carr Research Scholarship
Alec Willard and **Robert Holland**
AADR/Dentsply Sirona Student Award for Advancing Dental Research and Its Application
Rebecca Shembarger
King Saud University Travel Award for Excellence in Preventive Oral Health Care
Molly Sanders
IN-AADR-sponsored ASDA IUSD Student Research Group Award
Robert Holland
IN-AADR D4 Case Report Award
Andrew Corrado
Dean's Award for Research Excellence
Robert Holland
Research Honors Program Certificate of Achievement
Robert Holland, Sung-Kyung (JoAn) Kim, Ji Yoo Lee, Sable Staller, Alec Willard

Graduate Dental Students

King Saud University Ph.D. Student Travel Award
Hadeel Ayoub
King Saud University Travel Award for Best Clinical Case Report
Yu-Ting Yeh
Delta Dental Award for Innovation in Oral Care Research
Yu-Ting Yeh
Maynard K. Hine Award for Excellence in Dental Research
Hawra AlQallaf

Staff

IN-AADR Research Staff Award
Janice Warrick-Polakoff

Faculty

IU School of Dentistry Distinguished Faculty Award for Teaching
Dr. Daniel Shin
IU School of Dentistry Distinguished Faculty Award for Research
Dr. Chandler Walker
King Saud University Distinguished Research Faculty Travel Award
Dr. Yusuke Hamada

Poster Presentations

CARIOLOGY

P1 **Longitudinal Effects of SDF on Early Enamel Caries Lesions.** A.T. ALCORN*, L. AL DEHAILAN, N.B. COOK, Q. TANG, F. LIPPERT (Indiana University School of Dentistry)

Objective: Research has evaluated the effects of silver diamine fluoride (SDF) on cavitated lesions and lesions extending into dentin. However, little is known about SDF effects on early, incipient, non-cavitated white-spot, enamel caries lesions (EECL) and how SDF affects remineralization and prevention of further demineralization longitudinally. This study aimed to evaluate surface microhardness changes in EECL treated with SDF longitudinally. Hypotheses: 1. SDF treatment will result in increased surface microhardness of EECL compared to other treatments. 2. Delayed pH-cycling will result in greater surface rehardening in lesions treated with SDF compared to other treatments. Design: This laboratory study had 5 intervention groups (SDF, silver nitrate ($AgNO_3$), potassium fluoride (KF), 5% sodium fluoride varnish (FV), deionized water (DI)) × 2-time intervals after intervention (immediate & delayed pH-cycling), resulting in 10 groups (n=18). EECL were created in bovine enamel and extent of demineralization was determined using Vickers surface microhardness (VHN_{lesion}). Intervention treatments were applied. Half the specimens from each group underwent immediate 5-day pH-cycling and half were stored in an incubator with artificial saliva for two weeks before undergoing 5-day pH-cycling. After pH-cycling, lesion hardness was evaluated using VHN_{post}. ΔVHN calculated [VHN_{post} - VHN_{lesion}]. Data were analyzed using two-way ANOVA. Results: Immediately cycled, SDF had significantly ($p<.0001$) greater remineralization than DI, $AgNO_3$, and FV. All delayed cycling groups had significantly ($p<.0001$) greater remineralization than FV. Significantly greater remineralization was noted in delayed $AgNO_3$ ($p=<.0001$), DI ($p=.0003$), and FV ($p=.0006$) compared to immediately cycled. Conclusion: SDF could be a viable off-label treatment option for preventing demineralization in EECL, despite the unaesthetic dark staining associated with it. Longitudinally, SDF exhibited greater remineralization than both FV and DI groups, though not statistically significant.

P2 **Effects of Charcoal Dentifrices on Biofilm Development and Enamel Demineralization.** F.A. ALMADY*, B.H.D. PANARIELLO, A.A. AZABI, L.S. MOKEEM, F. LIPPERT, A.T. HARA, S. DUARTE (Indiana University School of Dentistry)

Purpose: To evaluate the *in vitro* effects of commercially available dentifrices containing charcoal on *Streptococcus mutans* biofilm development and their ability to prevent enamel demineralization. Methods: *S. mutans* biofilm was formed on polished bovine enamel specimens (n=9 per treatment), and treated twice-daily for 120 seconds over the course of 5 days with: charcoal dentifrice containing fluoride (1000 ppm F) (CF+), fluoride-free charcoal dentifrice (CF-), regular fluoride (1,100 ppm F) dentifrice (F+), or regular fluoride-free dentifrice (F-). Chlorhexidine (CHX, 0.12%) and deionized water (DIW) were used as positive and negative controls, respectively. Biofilms were analyzed for bacterial viability (colony-forming units, CFU). The pH of the medium was measured daily. Enamel specimens were analyzed using Vickers microhardness (HV) and transversal microradiography (TMR). Data were analyzed using one-way ANOVA followed by post-hoc tests ($\alpha=0.05$). Results: F+ showed higher pH values than CF+ and CF-, and CF- presented higher pH than CF+, showing that CF+ did not have inhibitory effects on the acidogenicity of cariogenic biofilms. CFU was significantly decreased when specimens were treated with CF+, CF- and F+, compared to specimens treated with DIW ($P\leq 0.035$) or F- ($P\leq 0.001$), respectively. However, the reduction observed was minimal (approximately 1 log). CF+ and CF- were less effective than F+ in preventing enamel demineralization as determined using HV ($P=0.041$ and $P=0.003$, respectively) and TMR ($P\leq 0.001$). Both dentifrices containing charcoal (CF+, CF-) did not show relevant inhibition of *S. mutans* biofilm growth, even in the presence of fluoride. Additionally, neither product prevented enamel demineralization compared to a regular fluoride-containing dentifrice.

P3 **Dietary Fluoride Intake of Pregnant Women from the ELEMENT Project.** G.A. CASTIBLANCO*[1], T.V. MUÑOZ-ROCHA[2], A. CANTORAL[2], M.M. TELLEZ-ROJO[2], K.E. PETERSON[3], H. HU[4], E.A. MARTINEZ-MIER[1] ([1]Indiana University School of Dentistry, [2]Center for Nutrition and Health Research National Institute of Public Health of Mexico, [3]University of Michigan School of Public Health, [4]University of Washington School of Public Health)

In order to increase our understanding of dietary fluoride intake during pregnancy and inform future recommendations, there is a need for reports of pregnant women's current dietary intake levels. The current recommendation is 3 mg F/day from all sources (US-Institute of Medicine). Sources of dietary intake in Mexico City include foods, beverages and fluoridated salt. Objectives: 1) to describe and compare dietary fluoride intake throughout pregnancy and 2) to determine how it relates to different levels of adherence to Mexican dietary recommendations. Methods: women living in Mexico City were recruited at the beginning of their pregnancy (n=571). At each stage (Early, Middle, Late) demographic questions and anthropometric measurements were collected. The daily dietary intake of fluoride (mg F-/day) and pregnancy's key nutrients from Mexican dietary guidelines were assessed with 3-month recall Food Frequency Questionnaires (FFQs). Demographic and nutritional data were summarized with non-parametric statistics. The comparison of dietary fluoride intake across pregnancy stages and levels of compliance with Mexican dietary recommendations was made with random effects' multiple linear regression models, adjusting for covariates. Results: Median unadjusted dietary fluoride intake throughout pregnancy was 0.69 mg F-/day (0.01 mg F-/kg/day). After adjustment for covariates, the association between dietary fluoride intake and pregnancy stage was significant ($p<0.05$). Predictive margins of dietary fluoride intake during pregnancy increased from 0.72 [CI: 0.70-0.74] in the early-stage, 0.76 [CI: 0.74-0.78] in the middle-stage, to 0.80 [CI: 0.78-0.82] mg F-/day in the late-stage. Women who were highly compliant with Mexican dietary recommendations ingested in average, 0.08 mg F-/day more than non-compliant women ($p=0.004$). Conclusion: Levels of dietary fluoride intake increased with the progression of pregnancy and in women who were highly compliant with Mexican dietary recommendations. (Financial Support: Indiana University's President's International Research Award (PIRA 23-140-39); NIH RO1ES021446: Prenatal and Childhood Exposure to fluoride and Neurodevelopment; PhD in Dental Sciences Program, Indiana University School of Dentistry; National Institute of Public Health of Mexico, INSP)

P4 **Validity of CARIOGRAM® for Early Childhood Caries Prediction.** C.E. MORAN-SANCHEZ*[1,2], A. ROMANO[2], M.F. RESENDIZ-VALENZUELA[1,2], P.U. MURISI[2], C. ALONSO[2], A.E. SOTO-ROJAS[1], G. CAMPUS[3], J.S. LARA[1] ([1]Indiana University School of Dentistry, [2]University of Guadalajara Tepatitlan de Morelos, Mexico, [3]University of Bern, Switzerland)

Objectives: To evaluate the validity of Cariogram® in relation to early childhood caries increment (natural development/progression of caries lesions) over a 12-month follow-up period Experimental approach: In 2018, a cohort of 409 Mexican preschool children (3-5 years old) received an oral examination to determine caries prevalence at different thresholds and associated factors. Additionally, the caries risk profile was also assessed using the Cariogram® software (excluding S. Mutans count, buffer capacity and salivary flow items). Caregivers were informed about children's oral status and encouraged to seek dental care. One year later, re-examination using the same criteria was performed on 381 subjects from the original sample (dropout 7.09%). Possible correlated variables were analyzed using the principal component analysis (PCA). The performance of Cariogram® in predicting caries incidence/increment was evaluated by the Receiver Operating Characteristic (ROC) analysis. Results: After one year, 36 (9.47%) subjects had developed new ICDAS 3-6 caries lesions. The first two eigenvalues of PCA analysis account for 71.68% of the total variance at baseline and 69.56%, at follow-up. In both D-plots of the first two principal coordinates, gingival status, diet content, and clinical judgment tend to form a separate cluster. Goodness of fit was high for these variables. Sensitivity measured by ROC analysis were 0.77 at baseline and 0.83 at follow-up, while specificity was 0.76 and 0.81, respectively, and the area under the ROC curve was 0.50 and 0.59, respectively. A strong association between caries risk profiles at baseline and dentinal caries incidence after one year was found. Conclusions: This study's results confirm the Cariogram® predictive validity for early childhood caries being a suitable, precise, accurate and easy-to-use model for caries risk assessment in young children.

P5 **Effect of Chlorhexidine/Thymol Varnish on Preventing Root Dentin Caries.** B.H.D. PANARIELLO*, M.J.R.H. ROMERO, F. LIPPERT, A.T. HARA, S. DUARTE (Indiana University School of Dentistry)

The increased retention of teeth in the oral cavity throughout life in the ageing population is one of the factors that have led to higher prevalence rates of root caries lesions. *Streptococcus mutans* is one of the key microorganisms linked with caries since it coordinates the assembly of cariogenic biofilms. Moreover, *Candida albicans* has also been found in such biofilms and may act as a secondary agent in caries lesion progression, especially in dentin. This study aimed to evaluate the effects of a chlorhexidine/thymol varnish (Cervitec Plus) on the prevention of root dentin caries using a combined *S. mutans* and *C. albicans* biofilm model. A mixed *C. albicans* SC5314 and *S. mutans* UA159 biofilm was formed on polished bovine dentin specimens for 48 h, and treated twice-daily with a fluoride-containing dentifrice (F+) and deionized water (DIW) for 120 seconds. The group treated with Cervitec Plus (V) had the varnish applied 24 h before the initiation of biofilm formation, and the varnish was removed with a scalpel to simulate the removal caused by oral hygiene or masticatory functions. Twice-daily after treatments, all specimens were remineralized for 30 min in human saliva diluted 1:1 with adsorption buffer. Biofilms were analyzed for bacterial and fungal viability by colony-forming units. The pH of the medium was measured daily. Dentin specimens were analyzed by transversal microradiography (TMR). The pH dropped on the group treated with DIW over the course of 48 h; however, V and F+ kept the pH around 6.5. Both V and F+ reduced the number of *S. mutans* compared to DIW, however, none of these treatments seemed to reduce *C. albicans* viability. TMR analysis showed that both V and F+ reduced lesion depth compared to DIW. Conclusion: Chlorhexidine/thymol varnish seems to have a protective effect against *S. mutans* on dentin.

P6 **Dental Caries and Quality of Life in Mexican Preschool Children.** M.F. RESENDIZ-VALENZUELA[1,2], P.U. MURISI[2], A. ROMANO[2], C. ALONSO[2], T.K. TEDESCO[3], G. CAMPUS[4], J.S. LARA[1] ([1]Indiana University School of Dentistry, [2]University of Guadalajara Tepatitlan de Morelos, Mexico, [3]Ibirapuera University, Brazil, [4]University of Bern, Switzerland)

Objective: The aim of this study was to determine the prevalence of dental caries in preschool Mexican children (3-5 years-old) and its impact on oral health-related quality of life (OHRQoL). Methods: A cross-sectional study including both private/public and rural/urban randomly selected preschools in Tepatitlan de Morelos, Mexico, was conducted. Data regarding OHRQoL were obtained using the validated version of the ECOHIS questionnaire for Mexican population (M-ECOHIS), whilst caries prevalence was clinically determined using the ICDAS criteria at two thresholds: subjects with at least one lesion in enamel or dentin (ICDAS 1-6) and subjects with at least one lesion in dentin (ICDAS 3-6). One-way ANOVA, chi-squared test, and a logistic regression model were used for data analysis. Results: Four hundred and nine children and their caregivers participated. Children were evenly distributed by sex, type of school and location. The prevalence of dental caries was 82% when considered lesions in enamel and dentin (ICDAS1-6) and 45% for lesions clinically in dentin (ICDAS 3-6). The mean M-ECOHIS scores for the domains 'impact on children' and 'impact on family' were statistically significant higher in children with moderate (ICDAS 3 and 4) and severe caries lesions (ICDAS 5 and 6). Supervised tooth brushing ($p<0.01$) and not reporting tooth pain ($p<0.01$) were positively associated with caries experience. Conclusion: Untreated cavitated caries lesions impact negatively the oral health-related quality of life of preschool children and their families in Mexico.

P7 **Influence of Silver Diamine Fluoride on Untreated Enamel and Dentin.** M.J.R.H ROMERO*, F. LIPPERT (Indiana University School of Dentistry)

Clinical studies reported that silver diamine fluoride (SDF) prevents the development of new lesions when applied to carious teeth, but the mechanism has yet to be established. This study assessed the indirect effect of 38% SDF on untreated sound and demineralized enamel and dentin using a single section model for longitudinal digital transverse microradiography (TMR-D). Methods: Forty-eight single sections of bovine radicular dentin demineralized to an integrated mineral loss ($\triangle Z$) of about 4500 vol%.µm, stratified into four clusters (n=12), were treated with either SDF or control deionized water (DIW). Treated dentin sections were attached between single sections of untreated sound (S) and demineralized (Dem) bovine enamel (E) or dentin (D) yielding a 2-block (E/D) 2x2 ((S/Dem); treatment of adjacent section (SDF/DIW)) factorial design. TMR-D was carried out for all sections for baseline and after 24 and 48 hours demineralization as well as treatment baseline for the treated dentin. $\triangle Z$ and lesion depths (LD) were assessed. Fluoride levels in the demineralization solution were also measured in

SDF-containing groups. Results: Repeated measures ANOVA (α=0.05) showed no significant increase in △Z for both sound (p=0.107-0.507) and demineralized (p=0.628-0.971) enamel and in LD of sound (p=0.137-0.318) enamel adjacent to SDF-treated dentin compared to control. Untreated dentin specimens showed a significant increase in △Z and LD over time but △Z of sound dentin adjacent to SDF-treated dentin was still significantly lower than control. Fluoride from SDF was released in the demineralization solution even after 48 hours. Conclusion: Within the limitations of this chemical model, 38% SDF, when applied to carious teeth inhibited demineralization in untreated sound enamel consistent with clinical findings and to a lesser extent, in untreated demineralized enamel, but not in dentin. This may be due to the fluoride SDF released into the solution. Further studies are needed to explore other possible mechanisms. (Supported by the Department of Cariology, Operative Dentistry and Dental Public Health, Indiana University School of Dentistry. Advantage Arrest™ Silver Diamine Fluoride 38% was provided by Elevate Oral Care®)

P8 Caries Prevention with Silver Diamine Fluoride Studied Under pH-cycling Conditions.

P. SORKHDINI*, R.L. GREGORY, Q.TANG, F. LIPPERT (Indiana University School of Dentistry)

Objectives: Silver diamine fluoride (SDF) has been effectively used to arrest active carious lesions. This study investigated the ability of SDF, and its individual components, silver and fluoride ions, in preventing enamel demineralization under pH cycling conditions in the presence or absence of twice-daily fluoride application. Methods: Polished human enamel specimens were assigned to five treatment groups (n=36 per group) after baseline assessment of sound enamel Vickers surface microhardness (VHN): 38% SDF (253,900 ppm Ag; 44,800 ppm F); 38% SDF followed by supersaturated KI application (SDF+KI); 42% $AgNO_3$ (silver control; 253,900 ppm Ag); KF (fluoride control; 44,800 ppm F); and deionized water (DIW; negative control). Treatments were applied once. Specimens in each treatment group were divided into two subgroups (n=18). During the subsequent 7-day pH cycling phase, specimens were treated twice daily with either 275 ppm fluoride as sodium fluoride or DIW, immediately before and after a 3-h cariogenic challenge with lactic acid solution and exposure to artificial saliva at all other times. VHN was determined again and changes from baseline calculated (∆VHN). Data were analyzed using ANOVA. Results: ∆VHN values for pH cycling with fluoride (mean±standard deviation) were: SDF (-61±9); SDF+KI (-61±15); KF (-62±11); $AgNO_3$ (-77±11); DIW (-77±4). ∆VHN values for pH cycling with DIW were: SDF (-71±7); SDF+KI (-74±8); KF (-60±12); $AgNO_3$ (-83±2); DIW (-84±2). In both models, SDF, SDF+KI and KF were more effective in preventing demineralization than $AgNO_3$ and DIW. There was no difference between SDF, SDF+KI and KF with twice daily fluoride treatments. However, KF was more effective in preventing demineralization than SDF and SDF+KI in the absence of fluoride treatments. KI did not affect the ability of SDF to prevent demineralization and was able to lessen the staining caused by SDF. Conclusions: SDF and SDF+KI may be viable options in preventing primary coronal caries.

DENTAL ANESTHESIOLOGY

P9 Intraoral Oxygen Concentrations in Dental Procedures during Office-Based Anesthesia.

R.R RAFLA*, J.E. JONES, J.F. YEPES, M.A. SAXEN, L.A. VINSON, G. ECKERT (Riley Hospital for Children and Indiana University School of Dentistry)

Purpose: This study aims to determine if oxygen accumulates in the oropharynx during dental procedures performed under deep sedation and general anesthesia by measuring the intraoral oxygen concentration as this is one of the main risks for surgical fires. It also aims to determine if the application of high-speed suction in the oral cavity reduces the intraoral oxygen concentration during these procedures. Methods: Up to 40 healthy children scheduled to undergo indicated operative dental procedures during office-based general anesthesia will be invited to participate. After a dentist anesthesiologist induces anesthesia and secures the airway with a nasopharyngeal airway or endotracheal tube, intraoral oxygen concentration will be measured using an oxygen sensor (Viasensor G210 Medical Gas Analyzer). After a 5 second intraoral use of the high speed suction, intraoral oxygen concentration will be measured for 75 seconds. Following this, the dentist will start tooth preparation and the high-speed intraoral suction will begin again as intraoral oxygen concentration is measured for an additional 60 seconds. Data will be evaluated using repeated measures ANOVA. Results: Initial data analysis on nineteen subjects with a mean age of 45.3 months has been conducted. Five used endotracheal intubation (ETT) as airway management and fourteen used nasopharyngeal airways (NPA). Oxygen concentrations increased in the oral

cavity in subjects with ETT and NPA prior to insertion of high-speed intraoral suction by 44% and 28%, respectively. Oral oxygen concentrations in all subjects increased above atmospheric oxygen concentration (21%). The oxygen concentration after the insertion of the high-speed intraoral suction decreased by 48% and 57% for ETT and NPA, respectively. Conclusion: The preliminary results of this study show that oxygen pooling does occur in the mouth during office-based anesthesia. It also finds that the oxygen concentration is greatly reduced when high speed suction is introduced into the oral cavity.

DENTAL EDUCATION

P10 Analysis of Interprofessional Practice and Cultural Competency in IUSD Curriculum. D.M. ALMEIDA*, L. ROMITO, A. SHUKLA, E.A. MARTINEZ-MIER (Indiana University School of Dentistry)

The objective of the current project was to analyze the Indiana University School of Dentistry (IUSD) curriculum for its content in the areas of cultural competence and interprofessional practice. The results of the analysis will be used to modify or develop new curriculum in order to better prepare dental students for interprofessional practice and enable them to provide culturally competent oral health care. To accomplish these goals, curricular maps of all IUSD classes were developed. Course directors were asked questions regarding their courses; for example, “Do students learn in your course about factors and practices associated with disparities in health status among subpopulations? These factors may be racial, ethnic, geographic, or socioeconomic in nature.” Surveys with these questions were sent to instructors through REDCap and all responses were recorded in the fall 2019 semester. Results showed that 5 out of 27 courses had an educational component regarding interprofessional practice and 32 out of 62 courses had an educational component regarding cultural competence. There was a significant difference in the number of courses which included educational components for each area. More than half of the classes surveyed included cultural competence content, but less than 25% included interprofessional practice, indicating different approaches will be needed for each area. In addition, there were sequencing issues and gaps in learning outcomes. In conclusion, survey responses indicated that there is a need for modification in the dental curriculum in the areas of interprofessional work and cultural competency. (Supported by Grant: HRSA T12HP31870 IN (IU) “Strengthening the Oral Health Workforce in Indiana through an Innovative Community Based Dental Education (CBDE) Model”)

DENTAL MATERIALS

P11 Smart Dental Adhesive Containing HNT-encapsulated EGCG for Long-Lasting Adhesive-Dentin Interface. S. ALHIJJI*, S.F. SOCHACKI, J.A. PLATT, L.J. WINDSOR (Indiana University School of Dentistry)

Dentin bonding technology is still developing since a half- century ago, but primarily to make them more user-friendly by simplifying the steps rather than improving durability. This study aims to develop “a smart” adhesive to protect the integrity of resin-dentin junction after restoration placement using a slow release of a therapeutic compound such as EGCG. The degradation of the resin-dentin interface is mainly attributed to matrix metalloproteinases (MMPs) and hydrolase activity associated with secondary caries progression. In this study, halloysite nanotubes (HNTs) were added to dental adhesive (3M ESPE, Adper™ Scotchbond™ Multi-Purpose), which used as a reservoir to allow sustained drug release of Epigallocatechin-3-gallate (EGCG). EGCG, the most abundant catechin in tea green tea extracts, has the ability to inhibit MMPs and potentially esterases. The effects of EGCG-HNT on the polymerization of the adhesive were investigated using FTIR to calculate the degree of conversion (DC) to evaluate the curing efficiency. The release of EGCG from HNT under different pH conditions simulating active caries pH changes was examined using UV-VIS. MMP-inhibition was evaluated using β-casein cleavage by MMP-9 exposed to low doses of EGCG. The results showed that EGCG (up to 2.4 mg/ml) did not alter the DC compared to the control group, while higher levels (11.5 mg/ml) of EGCG only decreased DC by up to 14% relative to the control. The addition of 15% (w/v) of unloaded HNT showed an increase of DC up to 4% in comparison to 15% (w/v) of HNT loaded with 2.4 mg/ml of EGCG. The EGCG release was increased up to two-fold at pH 2.6 compared to neutral pH. EGCG (0.216 mg - 1.25mg) showed inhibitory effects on MMP-9 (23-38 %, respectively). Therefore, HNT containing EGCG added to adhesive could have potential therapeutic advantages that may improve the longevity of bonding to dentin.

P12 Direct Cytotoxic Effects of Different Hemostatic Agents on Human Gingival Fibroblasts. T. ALRASHEED*[1], N. LABAN[2], H. ALOTAIBI[2], A. MOKEEM[1], M. ALJAMEL[2], D. ALI[2] ([1]Indiana University School of Dentistry, [2]King Saud University, Riyadh, KSA)

Purpose: To evaluate the cytotoxic effects of different hemostatic agents (including Expasyl) on human gingival fibroblasts (HGFs) in vitro. Materials and Methods: HGFs were cultured and exposed to either no medicament treatment or 1:200 dilution of six different hemostatic agents (Hemox-A, Hemodent, Astringedent, Vicostat, Expasyl, 3M ESPE) for 2, 5, 10 minutes, 1 hour, and 24 hours. Toxicity to HGFs was determined by lactate dehydrogenase activity (LDH) and colorimetric (WST-1) assays. Two-tailed t-test was used for statistical analyses with α level set at 0.05. Results: The group-by-time interactions were significant for the LDH and WST-1 assays ($p < 0.001$). Evaluation of the cytotoxic effect of different hemostatic agents at different incubation time intervals on the cell membrane damage revealed that Astringedent showed the highest cytotoxic effect on HGFs compared to other agents with regards to untreated negative control cells at all incubation time intervals ($p < 0.001$). On the other hand, Expasyl showed the least cytotoxic effect with significant differences at 5 minutes and 1 hour ($p < 0.001$) in comparison to other agents. Conclusions: LDH and WST-1 assays of hemostatic agents showed significant cytotoxic effect on HGFs at different time intervals. The data suggest that the risk for permanent tissue damage might be less significant when Expasyl is used during final impression procedure compared to when Astringedent is used.

P13 Effects of Luting Agent on the Retention of Fiberglass Reinforced Resin Crowns. E. DYER*, J.A. PLATT, S. SOCHAKI, J.E. JONES, B. SANDERS, J.E. KOWOLIK (Riley Hospital for Children and Indiana University School of Dentistry)

Purpose: This study aims to determine the effect of zinc phosphate, glass ionomer, resin modified glass ionomer, and self-adhesive resin luting agents on the retention of pediatric fiberglass reinforced resin crowns. Preformed fiberglass-reinforced resin pediatric crowns (Figaro, Inc., Woodbury, MN) are an esthetic, full coverage restoration. The luting agent for these restorations works to increase the crown's retention and resistance to displacement. Methods: Preformed fiberglass reinforced resin crowns for right primary mandibular first molars (n=40) were cemented to dentinal analog epoxy dies using equal amounts of zinc phosphate (Zinc Phosphate, Henry Schein), glass ionomer (Ketac-Cem, 3M ESPE), resin modified glass ionomer (GC Fugi PLUS, GC America), and self-adhesive resin cement (RelyX Unicem Aplicap, 3M ESPE) and subjected to thermocycling (5000 cycles at 5-55 ±2.5 degrees C). Following thermocycling, the samples were embedded in acrylic and mounted into a testing jig. Tensile retention testing was performed using the universal testing machine to failure. Results: Final results are pending final data analysis. Preliminary analysis indicates a significant difference among the groups ($p<0.00001$) with resin cementation providing the greatest retention for fiberglass reinforced resin crowns. Conclusion: This study will provide information on the effects of luting strategy on the retention of fiberglass reinforced resin crowns and will possibly provide insight on new methods for cementation of these restorations.

P14 Survival Rates of CAD/CAM Crowns Fabricated by Pre-doctoral Students. S. MANDAPATI*, O. CAPIN, L. AL DEHAILAN, T.P. THYVALIKAKATH (Indiana University School of Dentistry)

Objective: The objective of this study is to determine the survival rate of CAD/CAM prepared all-ceramic single crowns that were designed and fabricated by predoctoral students. In addition, different factors influencing the outcome are evaluated. Methods: This retrospective study was carried among medically fit patients that received CAD/CAM single crowns at IUSD from January 2013 to June 2019. Subjects that do not have a follow-up record after the crown delivery were excluded from the study. Patient data from Axium was extracted using SQL queries. The primary outcome – survival rate of all-ceramic crowns – was calculated using Kaplan-Meier analysis and Cox regression was used determine the confounding variables. SAS 9.4 software was used to perform the analyses. Results: Of 154 all-ceramic single crowns that constitute the final study sample, anterior and posterior crowns comprise 14% and 86% respectively. 43% of the units are endo treated. Twenty-one units failed due and most common reasons are open margin and de-cementation. Mean follow-up period is 3 years. Overall 2- year survival rate is 79% and 6-year rate is 76%. According to the study results, as the age of the patient increases, longevity

of the crowns decreases, but it is statistically insignificant (p>0.05). Endo treated teeth are 32% more likely to fail than vital teeth, but it did not reach statistical significance as well. Likewise, posterior crowns are 32% more likely to fail. There is no significant difference in survival rates based on caries risk status. Conclusion: Within the limitations of the study, the data demonstrates the acceptable survival rates. The survival of the all-ceramic single crowns does not depend on vitality, location, age, and sex of the patients.

ENDODONTICS

P15 Alzheimer's Disease and Dental Pulp - An Intriguing Link. Y. EHRLICH*, S. MUDUNURI, T. ZHU, C. WALKER, M. SRINIVASAN (Indiana University School of Dentistry)

Objective: Neuroinflammation is increasingly recognized as the third core pathological feature in Alzheimer's disease (AD) along with the characteristic accumulations of amyloid beta (Aβ) plaques and neurofibrillary tangles. The two-hit vascular hypothesis of AD suggest that the initial damage to blood vessels disrupt the microvasculature of blood brain barrier and diminish brain perfusion leading to neuronal injury and Aβ accumulation. Interestingly, a similar process leads to pulpal injury and degeneration following dental infection or injury. Increased permeability in the subodontoblastic network of capillaries and neurogenic inflammation are early changes following pulpal injury. Odontoblasts lining the periphery of the pulp are ectomesenchymal cells with low regenerative potential much like the neuronal cells. Hence, we speculated that in AD wherein the brain exhibits loss of neurons, the dental odontoblasts may exhibit similar changes. Methods: We used 5XFAD transgenic mice, an aggressive model of AD with five mutations closely linked with human AD. Brain and teeth from young (2-3weeks) and old (>8 weeks) old 5xFAD and wild type non-transgenic mice (control group) were harvested IACUC #19091. Histological analyses following routine hematoxylin and eosin staining and amyloid specific Congo red staining was performed. The blood vessels were counted using ImageJ software by three different blinded examiners. Student's t-test was used to determine the statistical significance in the number of vessels between the two groups. Results: Congo red positive amyloid plaques were observed in the brain and pulp of 5xFAD mice. Although the number of blood vessels in the pulp in 5XFAD mice had more blood vessels compared to wild type, the difference was not statistically significant. Conclusion: Presence of amyloid plaques and inflammation in uninfected dental pulp as in the brain suggest that there might be a plausible relation between the tooth and the brain in a mouse model of AD.

MICROBIOLOGY / IMMUNOLOGY / ORAL BIOLOGY

P16 Inhibiting Growth of *Streptococcus mutans* Biofilm Using Sugar-Hydrolyzing Enzyme Treatments. S. ALHAFFAR*[1], R.L. GREGORY[2] ([1]Indiana University-Purdue University Indianapolis, [2]Indiana University School of Dentistry)

Streptococcus mutans is a cariogenic bacterial species due to its ability to bind to the surface of the tooth and produce lactic acid, which demineralizes the enamel surface. The bacterial biofilm that performs this action is composed of the bacterial cells as well as extracellular polysaccharides (EPS) that cells secrete, which serve to hold the biofilm together and help it adhere to the surface. These EPS are primarily composed of polymers such as dextran, which can be cleaved using sugar-hydrolyzing enzymes such as invertase and dextranase. One portion of this study used crystal violet staining to examine the effects of various concentrations of the enzymes on *S. mutans* biofilm growth, as well as on established biofilm. Additionally, the study used a phenol-sulfuric acid assay to explore a possible mechanism of action of invertase and dextranase that involves a decrease in EPS production by bacterial cells. There was significant inhibition ($p < 0.05$) of biofilm formation in *S. mutans* samples treated with invertase and dextranase; of the two enzymes, dextranase demonstrated a significantly larger inhibitory effect on biofilm growth. Biofilm treated with invertase demonstrated up to a 40% decrease in absorbance, while samples treated with dextranase demonstrated up to a 55% decrease. Furthermore, the phenol-sulfuric acid assay confirmed that the enzymes' mechanism of action involves a significant reduction in the amount of EPS. Samples treated with invertase and dextranase demonstrated significantly less absorbance

in the colorimetric EPS assay, which suggests that the biofilm samples contain lower amounts of reducing sugars. Similar procedures were performed using sugar hydrolyzing enzyme beta-glucanase, however this enzyme demonstrated no significant effect on the *S. mutans* biofilm. The use of oral products containing these enzymes may provide significant reduction in oral biofilm of individuals using the enzymes.

P17 Inhibitory Effects of Preventative SDF Application on *Streptococcus mutans* Biofilm. R. AMIRI*, R.L. GREGORY, A. SCULLY, L.A. VINSON, S. DUARTE (Indiana University School of Dentistry)

Objectives: The purpose of this *in vitro* study was to investigate the preventative silver diamine fluoride (SDF) reagent application on intact enamel and the effects on establishment and proliferation of *Streptococcus mutans* biofilm, microhardness and pH. Methods: 5 µl of SDF or a stepwise combination of SDF and super saturated potassium iodide (SSKI; termed SDF+SSKI), and Riva Star was applied to prepared enamel specimens. 50 µl of an overnight *S. mutans* culture and 3 ml Tryptic Soy broth supplemented with 1% sucrose (TSBS) were incubated with treated specimens. Biofilm was collected, plated and an automated colony counter was used to determine the bacterial colony forming units (CFU/mL). Post treatment pH was measured. Change in microhardness of enamel specimens was measured before and after treatment and biofilm growth. Results: *S. mutans* CFU for enamel treated with SDF was significantly lower than all other groups ($p<.0001$). Microhardness significantly decreased for the control compared to SDF ($p<.0001$), SDF+SSKI ($p<.0001$), SSKI ($p=0.0305$), and Riva Star ($p=0.0015$); SSKI compared to SDF+SSKI ($p=0.0077$), and SDF ($p=0.0007$); Riva Star compared to SDF ($p=0.0166$). The pH was statistically higher for SDF compared to all other groups ($p<.0001$); SDF + SSKI pH compared to control ($p=0.0179$); SDF + SSKI compared to SSKI alone ($p=0.0242$). Conclusion: In a single-species *in vitro* model, application of SDF alone on intact enamel significantly reduced the subsequent establishment and proliferation of *S. mutans* biofilm. SDF + SSKI, SSKI, and Riva Star application did not have an impact on the *S. mutans* biofilm compared to the SDF alone treatment. Application of SDF, SDF + SSKI, SSKI, and Riva Star all significantly decreased the reduction of enamel microhardness. Application of SDF alone had a statistically higher pH and was consistently above critical pH of dental enamel.

P18 Effect of Garlic on *Streptococcus mutans* Collagen Binding. T. DIETL*, R.L. GREGORY (Indiana University School of Dentistry)

Objectives: To evaluate the ability of garlic to inhibit *Streptococcus mutans* from binding to collagen in the presence of nicotine. The long-term goal of this research aims to assess the ability of garlic as a therapeutic agent in the treatment of atherosclerosis. Methods: Garlic cloves were pressed through a garlic press into 47.5% ethanol to extract antimicrobial phytochemicals. The garlic was strained through a cheese cloth to remove large plant material. Trypticase Soy Broth (TSB) containing 1% sucrose (TSBS) was used to culture *S. mutans* with various concentrations of nicotine (0-32 mg/ml). Garlic was added at appropriate concentrations. 190 µL of nicotine/garlic/TSBS and 10 µL of a 24 h bacterial culture was added and incubated for 24 h. Collagen was added to every well, followed by primary rabbit anti-collagen antibody and secondary alkaline phosphatase labeled anti-rabbit IgG antibody. Binding of collagen to the *S. mutans* biofilm cells was measured using a spectrophotometer. Results: *S. mutans* treated with garlic alone without nicotine failed to bind collagen at 720, 360, 180, and 90 mg/mL of garlic. Collagen binding to *S. mutans* in the presence of 45 mg/mL garlic and varying levels of nicotine was significantly reduced ($p<0.05$) in the 16 mg/mL and 32 mg/mL of nicotine groups. Conclusions: In conclusion, the results of this study identified garlic as a potential therapeutic agent in preventing atherosclerosis by preventing *S. mutans* from binding to collagen even in the presence of nicotine.

P19 Multispecies Cariogenic Biofilm Treated with Different Exposure to Low-Temperature Plasma. L.W. FIGUEIRA*[1,2], B. PANARIELLO[1], C.Y. KOGA-ITO[2], S. DUARTE[1] ([1]Indiana University School of Dentistry, [2]São Paulo State University (UNESP) Institute of Science and Technology)

Less invasive methods for caries treatment aiming to avoid unnecessary loss of dental tissue are needed. Low-temperature plasma (LTP) shows promising antimicrobial activity. Our hypothesis is that LTP is an effective non-invasive tool for the disinfection of carious cavities previous to restoration procedures. The aim of this study is to determine the effects of LTP on *Streptococci* multispecies cariogenic biofilm. Effective parameters of LTP against multispecies biofilm composed of *Streptococcus gordonii, Streptococcus mutans* and *Streptococcus sanguinis* were established. LTP was generated by Argon (99.5% purity, 5.0 SLM flow rate) and electric discharge (system

power: 8 W at 220V, 50/60 Hz) at atmospheric pressure using the device Kinpen (INP). Microorganisms were activated in blood-agar and incubated at 37 °C for 48 h at 5% CO_2. Standardized suspensions (10^8 colony-forming unit - CFU/mL) were prepared at optical density of 600 nm. Suspensions were diluted, mixed and added to TSB broth supplemented with 0.2% sucrose at a final concentration of 10^6 CFU/mL. Biofilm was formed on hydroxyapatite discs incubated in 24 wells plates incubated for 48 h (37 °C, 5% CO_2), replacing media after 24 h. Multispecies biofilms were exposed to LTP and flow control (Argon gas) for 120, 60, 30 seconds. Chlorhexidine digluconate 0.12% (positive control-PC) and 0.89% NaCl (negative control-NC) were applied for 1 min. Number of viable cells were determined by recovered CFU/mL. Data were analyzed by one-way ANOVA with Tukey post-hoc test (α=0.05). Significant reductions in total viable CFU were observed after exposure to LTP when compared to the NC. For *S. mutans*, 5.62, 3.96, 3.55 Log_{10} (CFU/mL) reductions were observed after LTP exposure for 120, 60 and 30 seconds, respectively. LTP treatment eliminated *S. gordonii* and *S. sanguinis* from the biofilm (100% reduction). In conclusion, LTP presents significant inhibitory effect on a multispecies cariogenic multi-species biofilms model. (Supported by FAPESP - São Paulo research foundation; grant number: 2019/01676)

P20 Cannabidiol Effects on MMP Expression from Cigarette Smoke Responsive Fibroblasts.
N. GHEIBI DEHNASHI*, A.A. AZABI, K. AL NASR ALLAH, L.J. WINDSOR, (Indiana University School of Dentistry)

The recent increase in usage of Cannabidiol (CBD) oil has raised questions about its potential effects in the oral cavity due to its sublingual placement. CBD has shown some therapeutic benefits that includes anti-inflammatory, pain relief, anti-convulsive and anti-neoplastic. The anti-inflammatory effects are of particular interest due to the host-mediated inflammatory responses in periodontitis, which results in subsequent loss of the periodontal ligament, alveolar bone, cementum and gingiva. A primary risk factor for periodontal disease is tobacco, which increases the expression of matrix metalloproteinases (MMPs) from human gingival fibroblasts (HGFs) that leads to increased cell mediated collagen degradation. The purpose of this *in-vitro* study was to investigate the effects of CBD on cigarette smoke condensate (CSC) treated HGFs compared to untreated and CSC treated HGFs. The HGFs utilized were treated with and without 100 ug/ml CSC for 3 days before the conditioned media were collected and analyzed by gelatin zymography to determine if CSC increased MMP-1 production from HGFs compared to untreated cells. WST-1 and LDH assays of CBD treated HGFs were assessed to determine the highest non-toxic level and that did not affect cell growth, respectively. HGFs were then incubated for 72 hours with CBD (31.4 µg/mL), CSC, CBD and CSC, or nothing (control). The conditioned media were collected for analyses for changes in MMP expression by MMP protein arrays. HGFs increased MMP-1 production when treated with CSC. The highest non-toxic level examined of CBD that did not affect cell growth was 31.4 µg/mL.

P21 Comparison of Osteoclast Formation from Myeloid Progenitor Sub Populations.
M. HAWKINS*[1], D. KANAGASABAPATHY[2], J.M. HONG[1], M.A. KACENA[2], A. BRUZZANITI[1] ([1]Indiana University School of Dentistry, [2]Indiana University School of Medicine)

Hematopoietic stem cells (HSCs) are characterized as having the ability to differentiate into multiple types of cells found within the blood and bone. HSCs give rise to the bone marrow macrophages (BMM) that can differentiate into the multinucleated bone degrading cells located on bone surfaces. Recently, it was reported that the bone-resident osteal macrophages (OM) can form osteoclasts in vitro. In order to gain a better understanding of the properties of the two myeloid progenitors, analysis of the osteoclast differentiation associated with each cell type (OM & BMM) was completed. OM and BMM cells were isolated from bone marrow of mice by fluorescence-activated cell sorting (FACS) based on the expression of F4/80 and CD45 surface markers. Sorted cells were differentiated into osteoclasts in growth media containing 80 ng/ml RANKL and 10 ng/ml MCSF for up to 15 days. Osteoclast number was enumerated using tartrate resistant acid phosphatase (TRAP) staining at several time points. Current results suggest that in the in-vitro model, BMMs initially lead to an increase in osteoclast formation, but OM progenitors show more sustained osteoclasts formation over time. These findings suggest that OMs contribute to osteoclast formation and increased bone resorption, which may be associated with bone metabolic disorders such as osteoporosis.

P22 Effects of Cannabidiol on Cytokines from Treated Human Gingival Fibroblasts. U. JANU*, K. AL NASR ALLAH, A.A. AZABI, L.J. WINDSOR (Indiana University School of Dentistry)

Background: *Cannabis sativa*, commonly known as marijuana, is the most frequently used illicit drug for recreational purposes. Cannabidiol (CBD) is the major non-psychotropic constituent of *Cannabis*, composing as much as 45-50% of *Cannabis* extracts. It has been suggested that the use of CBD might reduce inflammation as it occurs in Periodontitis. Tobacco is a significant risk factor for the development and progression of Periodontitis. Aim: To evaluate the effects of CBD on cytokine expression from cigarette smoke condensate (CSC) treated human gingival fibroblasts (HGFs) in vitro. Methods: In order to determine the highest non-toxic level of CBD that does not affect cell proliferation, the effects of CBD on HGFs cell proliferation and cytotoxicity were assessed using WST-1 and LDH assays at different CBD concentrations, respectively. HGFs were then incubated for 72 hours in serum-free media with CBD (31.4 µg/mL), with CSC (100 µg/mL), with CBD and CSC, or with neither. Conditioned media were collected and examined for changes in cytokine expression using cytokine protein arrays. Results: It was determined that 31.4 µg/mL of CBD was not toxic to the cells and did not affect cell growth, while all the higher concentrations examined did. Conclusion: CBD at 31.4 µg/mL or lower does not affect cell proliferation and is not toxic to HGFs. Determining the ability of CBD to reduce the cytokines increased by CSC will aid in determining whether CBD has any therapeutic value for the treatment of periodontitis in the future.

P23 Effects of Cannabidiol and *Porphyromonas* gingivalis on Human Gingival Fibroblasts. S. KAPOOR*, K. AL NASR ALLAH, A.A. AZABI, L.J. WINDSOR (Indiana University School of Dentistry)

Background: Cannabis sativa, also known as marijuana, is the most commonly used illicit narcotic used for recreational purposes. Cannabidiol (CBD) is a non-psychotropic component of Cannabis and constitutes around 40% of Cannabis extract. It has been suggested that CBD may have anti-inflammatory properties. Thus, CBD might reduce the inflammation that occurs in periodontal diseases. Purpose: The purpose of this study was to assess the effects of CBD on cytokine expression from Porphyromonas gingivalis (Pg) treated human gingival fibroblasts (HGFs) in vitro. Methods: In order to determine the highest nontoxic concentration of CBD that did not affect cell proliferation for the study, the effects of CBD on HGFs cell proliferation and cytotoxicity were assessed using WST-1 and LDH assays, respectively. HGFs were incubated for 3 days in a serum free medium with CBD (31 µg/ml), with 5 % Pg supernatant, with CBD and Pg, or without either. The media was then collected and analyzed for changes in cytokine expression using cytokine protein arrays. Results: The WST-1 and LDH assays determined that 31 µg/ml was not toxic to HGFs and did not affect their cell proliferation, as did all the other higher CBD concentrations examined. Conclusion: CBD at 31.4 µg/mL or lower concentrations does not affect cell proliferation and is not toxic to HGFs. Determining the ability of CBD to reduce the cytokines increased by Pg will aid in determining whether CBD has any value in the future for the treatment of periodontal diseases.

P24 The Effects of Kalirin Deletion on Osteocyte Function. S. KAWAK*, J.M. HONG, A. BRUZZANITI (Indiana University School of Dentistry)

Osteocytes are derived from matured osteoblasts. Osteocytes reside in the mineralized matrix of bone and control bone mass and quality. They have a unique morphology consisting of a cell body and membrane extensions know as dendrites, which are located within canaliculi in bone, and enable osteocytes to communicate with other bone cells. Dr. Bruzzaniti's lab observed that deletion of the GTP-exchange factor (GEF), Kalirin, in mice (Kal-KO) leads to a decrease in osteocyte dendritic length and low bone mass. To examine the mechanism of osteocyte dendrite growth by Kalirin, MLO-Y4 osteocytic cells were transfected with cDNA encoding the different protein domains of Kalirin, and dendrite length was measured after 3 days. The Kalirin GEF1 domain was found to increase dendrite length almost 2-fold. We next investigated the MAPK/ERK pathway in dendrite elongation. MLO-Y4 cells expressing GEF1 were treated with PD98059 (10 µM or 50 µM) for 2 h or 48 h, and then analyzed microscopically. PD98059 blocked dendrite growth by the Kalirin GEF1 domain. These studies confirm that Kalirin along with the MAPK/ERK regulate dendritic length in osteocytes. In future studies, we will determine if the dendritic length has an effect on osteocyte signaling.

P25 Combined Effect of Nicotine and Caffeine on *Streptococcus Mutans* Biofilm. S. KHATRA*, R.L. GREGORY (Indiana University School of Dentistry)

Caffeine and nicotine have affected a majority of today's population. *Streptococcus mutans* is a commonly found bacterium in the oral cavity. *S. mutans* grows on tooth surfaces as a biofilm and produces significant amounts of lactic acid from metabolism of sucrose which demineralizes enamel causing dental caries. Nicotine and caffeine have been known to affect the growth of this bacterium. Specifically, nicotine has been reported to significantly increase *S. mutans* biofilm formation *in vitro* which is correlated with the clinical observation that smokers develop higher levels of dental caries than non-smokers. However, caffeine inhibits *S. mutans* biofilm formation. To some extent caffeine and nicotine have been shown to have possible health benefits. This study investigated the correlation between *S. mutans* bacteria biofilm growth with different concentrations of caffeine alone, nicotine only, and nicotine combined with caffeine. The agents (ranging from 0-32 mg/ml) along with the bacteria were incubated for 24 hours followed by a crystal violet biofilm staining assay. The results indicated that lower nicotine concentrations exhibited significantly increased ($p<0.05$) biofilm formation while higher concentrations such as 8, 16, and 32 mg/ml demonstrated biofilm inhibition. Most of the caffeine concentrations reduced biofilm formation. The combination of nicotine and caffeine demonstrated significantly reduced biofilm formation. These results indicate that the combination of nicotine and caffeine may provide protection from the enhancing activity of nicotine. This suggests that smokers that drink caffeinated beverages may have less *S. mutans* in their dental plaque and subsequently lower incidence of dental caries.

P26 Effects of SDF and KI on 3 Bacterial Species Biofilm. L. LONG*, L.A. VINSON, B. SANDERS, S. DUARTE, R.L. GREGORY (Riley Hospital for Children and Indiana University School of Dentistry)

Purpose: The purpose of this *in vitro* study was to investigate the effects of 38% silver diamine fluoride (SDF) with and without a saturated solution of potassium iodide (SSKI) on *Lactobacillus casei, Actinomyces naeslundii* and *Streptococcus sanguinis* biofilms. Methods: Overnight cultures of *L. casei, A. naeslundii* and *S. sanguinis* were incubated in quadruplicate in 6-well plates. Each species was distributed into 4 groups consisting of an untreated control group and 3 treatment groups; SDF alone, SSKI alone, and SDF+SSKI. The experiment was replicated three times. Each group was treated with the individual test substances and the combination of SDF+SSKI including a stepwise protocol in which saline was used to wash the biofilms between the application of each reagent. The remaining biofilm cells were collected and colonies enumerated on blood agar plates. Results: The data demonstrated that both SDF and SDF + SSKI significantly reduced ($p<0.05$) the viability of cariogenic species *L. casei, A. naeslundii,* and the early-colonizer bacterial species, *S. sanguinis.* SSKI alone significantly reduced the viability of *L. casei (p<0.05),* but did not have significant inhibitory effects on *S. sanguinis* or *A. naeslundii.* ($p>0.05$). Conclusion: The results provide relevant information on developing the clinical protocol of managing caries with SDF and SSKI. It also provides insight for the first time on the effects of SDF alone and SDF+SSKI on the cariogenic species *L. casei* and *A. naeslundii,* and the early colonizer *S. sanguinis*.

P27 Effects of *N*-Demethylation Nicotine Metabolites on Oral *Streptoccoci* Biofilm Formation. R.A. MCKINNEY*, R.L. GREGORY (Indiana University School of Dentistry)

Cigarette smoking, the most common form of tobacco exposure, exposes the oral cavity of smokers with nicotine, both during the act of smoking and for an extended period afterwards. Numerous studies have revealed a positive correlation between smoking and the incidence of dental caries. Nicotine has been consistently shown to enhance biofilm formation of *Streptococcus mutans*, the key contributor to the formation of dental caries, at physiologically relevant concentrations – between 0.25 and 4.0 mg mL^{-1}. *Streptococcus sanguinis* is considered a relatively benign, and even beneficial, bacterium with regard to dental caries, as it can out-compete *S. mutans*, delaying its colonization and subsequent cariogenic activity. Previous studies have indicated that *S. sanguinis* growth is not as significantly impacted by the presence of nicotine compared to *S. mutans.* The major metabolic pathway of nicotine is the *N*-demethylation pathway. In this pathway, nicotine is broken down into a series of intermediates. *S. sanguinis* was exposed to nicotine as well as these intermediates – norcotinine, nornicotine, cotinine, and trans-3'-hydroxycotinine – at physiologically relevant concentrations (0.125, 0.25, and 0.5 mg/mL). Each treatment was analyzed via crystal violet staining for biofilm formation and direct spectrophotometric kinetic growth analysis. *S. sanguinis* biofilm formation was significantly increased compared to the zero control at a concentration of 0.5 mg mL^{-1} *trans*-3-hydroxycotinine and 0.5 mg mL^{-1} nornicotine. Norcotinine, a separate end-product metabolite, was

previously found to completely inhibit *S. mutans* biofilm formation at 0.5 mg mL $^{-1}$. These compounds are all end-product metabolites from the pathway, suggesting that as nicotine is broken down, healthier bacteria can begin to repopulate the oral cavity of smokers; as *S. mutans* is inhibited and *S. sanguinis* is upregulated. This interplay could also influence why more smoking patients present with higher incidence of periodontal disease compared to rampant caries. (Supported by the IUSD Dental Student Research Group Fund)

P28 Combined Effects of Soft Drinks and Nicotine on *Streptococcus Mutans*. L. MOKEEM*, N.B. COOK, L.J. WINDSOR, R.L. GREGORY (Indiana University School of Dentistry)

Objective: This study aimed to explore the combined effect of different types of soft drinks (regular, sugar-free and caffeine-free) and nicotine on the activity of *Streptococcus mutans* and biofilm formation. Materials and methods: A Tryptic Soy broth (TSB) starter culture of *S. mutans* was grown overnight. The next day, 8 mg/ml of nicotine were diluted in Tryptic Soy broth supplemented with 1% sucrose (TSBS). Then a dilution of 1:3 of soft drinks in the nicotine–TSBS was prepared for each type of soft drink examined (cola, diet cola, cola zero, caffeine-free cola, caffeine-free diet cola, and caffeine-free cola zero). The microtiter plate was incubated for 24 h, the wells were washed, fixed and stained with crystal violet dye and the absorbance measured to determine biofilm formation. A spectrophotometer was used to determine total growth absorbance and biofilm growth. Metabolic activity was measured based on the ability of biofilm in reducing XTT to a water-soluble orange compound. Results: There was a considerable effect for HFCS and caffeine, in the presence of nicotine, and their interaction in all measures: total growth, biofilm formation, and metabolic activity. One-way ANOVA was used for comparison. Conclusion: Sugar-free and caffeinated soft drinks demonstrated a strong effect in inhibiting *S. mutans* biofilm formation as well as metabolic activity in the presence of nicotine. On the other hand, nicotine-induced *S. mutans* exhibited increased biofilm formation and metabolic activity in the presence of HFCS and the absence of caffeine in soft drinks. Therefore, smokers with a high consumption of soft drinks should consider shifting to sugar-free and caffeinated versions in order to minimize their chance of developing dental caries by reducing biofilm formation.

P29 Effects of Blood Glucose Medications on *Streptococcus mutans* Biofilm Formation. W.F. TRAVIS*, R.L. GREGORY (Indiana University School of Dentistry)

Background: Over 29 million people in the US alone suffer from diabetes, resulting in more than one in ten over 20 years of age being affected. This disease claims the lives of seventy-nine thousand yearly, and those who do not ultimately succumb to the disease, live with side effects such as an increased risk of dental caries. The majority of dental caries is the result of one particular pathogen, *Streptococcus mutans*, which creates a biofilm and utilizes increased glucose in saliva to create acid and demineralize enamel. While the effects of salivary glucose are well noted with respect to this bacterium, the actions of other agents found in saliva of diabetics, including the pharmaceuticals used to treat diabetes, are not. Objective: The objective was to determine whether medications such as metformin, glipizide and empagliflozin have an effect on the biofilm growth of *S. mutans*. Methods: Effects were assessed by growing *S. mutans* in tryptic soy broth containing 1% sucrose and dilutions of the medications metformin (0-5 mg/ml), empagliflozin (0-1 mg/ml) and glipizide (0-1 mg/ml) which are above and below normal salivary levels in 96 well microtiter plates. The absorbance of each well was measured after 24 hours followed by measurement of biofilm formation using a crystal violet biofilm staining assay. Hypothesis: It was hypothesized that all the tested medications would increase the rate of *S. mutans* biofilm formation. Results: Empagliflozin, the SGLT-2 inhibitor, demonstrated significant inhibitory effects ($p<0.05$) on *S. mutans* total absorbance and biofilm formation at physiologic levels (1 and 2 mg/ml). Metformin and glipizide demonstrated no effects on *S. mutans* absorbance or biofilm formation at doses currently taken by diabetic patients. Conclusion: Switching medications for diabetics that struggle with oral hygiene to an SGLT-2 inhibitor could help control caries, provided additional studies are conducted to observe the clinical effects of the SGLT-2 inhibitors.

P30 Effects of Cannabidiol on Oral Squamous Cell Carcinoma Cells *in-vitro.* M.A. TUDARES*, A.A. AZABI, L.J. WINDSOR (Indiana University School of Dentistry)

Squamous cell carcinoma (SCC) of the oral cavity is a malignant cellular growth. The pathogenesis of its invasiveness has not been completely deciphered yet. Matrix metalloproteinases (MMPs) play major roles in the extracellular matrix degradation mediated by SCC. The antiproliferative properties of Cannabidiol (CBD) have

been documented in other organs, but CBD potential for inhibiting oral cancer invasion is not fully explored. The production of MMP-2 from SCC cells treated with CBD *in-vitro* was analyzed here in order to explore the potential anti-invasiveness properties of CBD on SCC. Methods: SCC-25 cells were grown in media with serum, L-Glutamine, Pen-strep, and amphotericin B. SCC-25 cells were then treated with and without CBD for 3 days before the supernatants were collected and analyzed for MMP production by gelatin zymography. Results: SCC-25 cells grew in clusters without covering the entire dish surface. Cells within the clusters were in direct contact with each other, but there was no contact between clusters of cells. A cleavage band of approximately 72 kDa was detected corresponding to MMP-2 (gelatinase A) activity. Bands of similar molecular weight were detected in the other samples. It was noted that the band intensity were similar between the control and CBD treated. Conclusion: Even though the cleavage bands were not easy to measure, these results suggest that production of MMP-2 secreted by SCC-25 cells was not altered by CBD and that SCC invasiveness *in-vitro* merits further efforts to investigate its therapeutic effects by examining other MMPs or proteases.

P31 Effects of Casein on *Streptococcus mutans* Biofilm Formation. A. VORIS*, L.A. VINSON, S. DUARTE, G. ECKERT, R.L. GREGORY (Riley Hospital for Children and Indiana University School of Dentistry)

Purpose: The purpose of this study was to investigate the effect that casein, alpha casein, beta casein, and kappa casein have on biofilm growth of *S. mutans*. Protein supplements are generally composed of various types of amino acids and polypeptides, including casein. These supplements are marketed to provide the raw materials that are necessary for both muscle construction and repair. It has been shown that the diet of athletes is consistent with a high-risk profile for dental caries. It was anticipated that the addition of the various caseins to *S. mutans* will enhance biofilm formation and growth to a greater extent compared to control samples of *S. mutans* biofilm not exposed to casein. Methods: *S. mutans* was treated with various concentrations of casein, alpha casein, beta casein, and kappa casein for 24 h. To test for biofilm formation, *S. mutans* was then cultured on blood agar plates for 24h and colonies were counted. Results: Complete results are pending statistical analysis. Partial statistical analysis performed thus far has revealed that a 6.25 mg/ mL concentration of the casein solution significant increases ($p < 0.05$) *S. mutans* biofilm formation compared to the control. Conclusion: The results of this study demonstrate that casein significantly affects *S. mutans* viability and biofilm mass. The increase in *S. mutans* biofilm formation was associated with an increase likelihood of the development of carious lesions in individuals who use casein.

ORAL DISEASE PREVENTION AND DIAGNOSIS

P32 Effect of Noise Reduction on Accuracy of Apical Root Resorption. H. RAHIMI*, H. TURKKAHRAMAN (Indiana University School of Dentistry)

Objectives: Radiologic diagnosis of external root resorption (ERR) is a substantial factor for a proper treatment plan and a successful outcome. Considering the importance of radiography in the accurate diagnosis of ERR and effect of noise on diagnostic performance, the aim of present study was to evaluate the effect of noise reduction algorithm on the diagnostic accuracy of apical ERR using periapical indirect digital radiography. Materials and methods: A total of 66 single-rooted premolar teeth were selected for the study. The samples were inserted in dried mandibles of sheep and fixed with pink modeling wax. Digital images were obtained using parallel technique. The storage phosphor plates were processed in the Digora Optime scanner. The resulting images were sent to a computer using the Scanora software for radiographic analysis. The teeth were removed from the mandible and artificial ERR defects were simulated. Afterward, the indirect digital X-ray images were obtained at the same condition of the baseline. Five levels of noise reduction were used to creating enhanced image. All images were saved in DICOM format and monitored by two observers twice over a period of two weeks. Data were analyzed using SPSS, Cochran, McNemar, and Kappa tests ($\alpha = 0.05$). Results: The highest sensitivity rate was found in “without noise-reduction” method (0.99) and the lowest sensitivity was related to “four-time noise reduction” method (0.91). The highest specificity rate was in “five times noise reduction” method (0.88) and the lowest

specificity was associated with “one-time noise reduction” method (0.71). There was no statistical difference between images with/without noise reduction enhancement with varied gradation levels on the diagnostic accuracy of apical root resorption (P > 0.05). Conclusion: Application of noise reduction in Scanora software might have no effect on the diagnostic accuracy of apical ERR.

P33 Cornulin in Predicting the Progression of Oral Premalignant Lesions. R. SHEMBARGER*[1] K. MCNAMARA[2], J. KALMAR[2], N. SANTOSH[1] ([1]Indiana University School of Dentistry, [2]The Ohio State University College of Dentistry)

Objective: Timely diagnosis of oral squamous cell carcinoma (OSCC) is crucial as early stage lesions have an 84% 5-year survival rate while late stage lesions have only 39% survival rate. OSCC often develops from premalignant lesions exhibiting oral epithelial dysplasia (OED); however, not all OEDs progress into OSCC and better understanding of the malignant transformation process is needed. We reported previously that cornulin is down-regulated as the severity of OED increases, and is absent in OSCC compared to normal oral mucosa. The objective of the current study is to determine the differential expression of cornulin in patients whose OED progressed to OSCC compared to those with non-progressive OED. Methods: Following database review of Oral Pathology Group at Indiana University School of Dentistry and Oral Pathology Consultants at Ohio State University College of Dentistry, 10 patients with OED that progressed into OSCC (progressive group) and 10 patients with OED that persisted without evidence of malignant transformation (non-progressive group) were identified. Following immunohistochemistry, cornulin expression was analyzed using Aperio imagescope software and a histo-score was calculated based on the intensity of the staining and the percentage of positive cells. Statistical analysis was performed using repeated measures ANOVA. Results: Cornulin is strongly expressed in the initial biopsy of non-progressive group compared to the initial biopsy of progressive group ($p<0.001$). No significant difference in cornulin expression was observed between non-progressive initial biopsy and subsequent biopsy; however, cornulin expression significantly reduced between progressive initial biopsy and subsequent biopsy that progressed to OSCC ($p<0.001$). Conclusion: Cornulin expression is significantly low in patients whose OED progressed to OSCC compared to non-progressive group, making it a promising biomarker to predict OED progression. This may help identify high-risk OEDs which require more aggressive management, thereby facilitating personalized treatment in the prevention of OSCC.

ORTHODONTICS / IMAGING / CRANIOFACIAL

P34 Lrp5 Gene Over-expression Leads to Decreased Tooth Movement. R. HOLLAND*, C. BAIN, A. ROBLING, A. UTREJA (Indiana University School of Dentistry)

Lrp5 (Low-density lipoprotein receptor-related protein 5) is a co-receptor of the Wnt intracellular signaling system. The Wnt system is known to play an important role in bone biology. Increased activity of the Wnt system leads to an increase in bone mass. The aim of this study was to compare tooth movement in genetically modified Lrp5 knock-in mice to control mice. Thirty-six C57BL/6 wildtype mice were utilized. Eighteen possessed a A214V mutation and eighteen possessed a G171V mutation in the Lrp5 gene. Twenty wild type C57BL/6 mice served as control. Experimental tooth movement was produced by attaching a 3mm closed-coil nickel-titanium spring from the first molar to the incisors. Tooth movement occurred for three weeks prior to sacrifice. For all but six mice, a microchromotagraphy scan was taken after sacrifice followed by a histologic analysis. The remaining six mice were Mice were injected with Calcin, Alizeren and Tetracycline at eight, four and two days pre-sacrifice respectively. These mice were processed in plastic and analyzed with fluorescent microscopy. Genetic knock-in mice showed higher percent bone volume (BV/TV), lower bone surface/volume ratio (BS/BV) and increased trabecular thickness (Tb.Th) compared to the control group. Cellular expression of the Sclerostin gene was higher per unit area in the genetic knock-in mice compared to the control mice. Fluorescent microscopy showed decrease in bone turnover in the genetic knock-in mice compared to the control. This study demonstrates that overexpression of the Lrp5 gene leads to an increased bone density, decreased bone turnover and a decreased rate of tooth movement in mice. Further study should be completed on the Wnt signaling pathway as this could lead to improvement of future orthodontic treatments.

P35 Dentoalveolar Changes in Class II/Division 2 Patients Using .018" Appliances. S. TWIGGS*, L. STETZEL, L. HELMS, K.T. STEWART (Indiana University School of Dentistry)

Objectives: The goal of this retrospective study was to assess whether the retroclined maxillary incisors associated with Class II Division 2 patients can be uprighted to their normal inclination, without placing additional torque to the archwire, using a pre-adjusted edgewise bracket system. Experimental methods: A sample population of 42 Class II Division 2 patients was obtained with equal numbers of male and females. Study inclusion criteria included: individuals age 20 or younger, utilization of a .018" pre-adjusted edgewise appliance, archwire progression to a .016x.022" stainless steel wire. The following diagnostic/treatment information was obtained for each subject: age, gender, ethnicity, treatment duration, appliances used (wires/brackets), initial (T_0) & Final (T_1) CBCT images, and T_0 & T_1 molar classification. Cephalometric measurements from the T_0 & T_1 CBCT images were recorded for analysis, using 111 +/-4° as a normative value for incisor inclination. Mixed-model ANOVA was used to compare T_0 & T_1 measurements, while accounting for within-subject correlations and allowing the T_0 & T_1 measurements to have different variances. A 5% significance level was used for all tests. Results: The incisor inclination values for the study population overlapped with the normative data regarding incisor inclination for both initial and final timepoints. However, the study population had significantly lower initial mean inclination values at the initial evaluation (106.67°) and significantly higher final mean values at the final evaluation (119.34°) ($p<0.05$). Incisor inclination ($p<0.001$) and buccal bone ($p<0.001$ long axis, root apex; $p<0.001$ long axis, ½ between apex and CEJ) increased significantly from T_0 to T_1. SNA ($p=0.027$) and ANB ($p<0.001$) decreased significantly during treatment, but no significant change was seen for SNB ($p=0.299$). Conclusion: The results suggest that a 0.018 pre-adjusted orthodontic appliance can elicit a significant change to maxillary incisor inclination and increased incisor buccal bone width without utilization of additional treatment strategies. (Supported by Dr. Lana Helms, adjunct faculty in the Indiana University School of Dentistry, Department of Orthodontics & Oral Facial Genetics)

PEDIATRIC DENTISTRY

P36 Effects of Pediatric Dental Crowns on Human Gingival Fibroblasts. K. BRAUER*, J.F. YEPES, A. SCULLY, K. AL NASR ALLAH, A.A. AZABI, L.J. WINDSOR (Riley Hospital for Children and Indiana University School of Dentistry)

Purpose: There is a substantial need for more research regarding the biocompatibility of stainless steel, zirconia, and fiberglass reinforced resin pediatric dental crowns. The purpose of this study was to examine the effects of eluates from these biomaterials on the cytotoxicity and cytokine expression from human gingival fibroblasts (HGFs). Methods: Crowns of each material were placed in serum free Dulbecco's Modified Eagles Medium and incubated at 37 °Celsius for 7 days. The eluates were then collected, sterile filtered, and dilutions (50%, 25%, 12.5%, and 6.25%) tested for cytotoxicity on HGFs via lactate dehydrogenase (LDH) assays. The highest, non-toxic concentration (50%) of each eluate as determined by the LDH assays were used to treat HGFs for 3 days before being collected and stored at -20 degrees Celsius. The cytokine protein arrays will be performed using this conditioned media. Results: LDH assays of the conditioned media from eluate treated HGFs identified no significant cytotoxicity (all P>.05) from any of the eluates. HGFs were then treated for 3 days in serum free media with and without 50% of each eluate. The conditioned media were then collected and stored until performing the cytokine protein arrays. Conclusion: The results of the LDH assays demonstrated that all dilutions of the eluates examined had no significant cytotoxicity to the HGFs. The HGFs were treated with and without 50% dilutions of each eluate in triplet and stored until performing the cytokine protein arrays to determine if one material was more biocompatible in regard to cytokine expression.

P37 Pediatric Phantom Dosimetry of the Portable Xray2Go Dental X-ray Device. J.J. HWANG*[1], J.F. YEPES[1], L.A. VINSON[1], J.E. JONES[1], B.J. SANDERS[1], T. WARE[1], K.B. JOHNSON[2] ([1]Riley Hospital for Children and Indiana University School of Dentistry, [2]University of North Carolina-Chapel Hill)

Purpose: Our study quantified radiation dose for tissues of a pediatric phantom head, from bitewing and maxillary anterior occlusal projections using the XTG (Xray2Go) Handheld X-ray device (Digital Doc, LLC, El Dorado Hills, CA). We aimed to evaluate thyroid shielding effects, quantify backscatter radiation, and compare our measured equivalent and effective doses with values obtained from a similar study of the NOMAD unit. Methods: A pediatric phantom head outfitted with 24 tissue site dosimeters was exposed to radiation from the Xray2Go. Exposure types

included 1) Right and left bitewing (PBW) projection without thyroid collar on phantom, 2) PBW with thyroid collar, 3) upper anterior occlusal (AO) projection without thyroid collar, 4) upper AO with thyroid collar. With each exposure type, a new dosimeter set was used and 30 exposures were completed. The operator wore dosimeters on forehead and hand to quantify backscatter radiation. The experiment was run three times. Dosimeters were processed by a MicroStar reader. One-way ANOVA was used to identify effects of the thyroid collar. Two-way ANOVA was used to compare the dosimeter readings of the Xray2Go and Nomad devices, with previous study data. Results: Thyroid shielding produced a statistically significant difference for posterior bitewing projections at thyroid (*P*=.0002), lymphatic nodes (*P*=.0367), and muscle tissue sites (*P*=.0367). Operator backscatter radiation from the XTG was extremely low; indistinguishable from background radiation. Our results showed that for many phantom tissue sites and the overall effective dose *(P*< .0001), the Xray2Go resulted in significantly lower doses than those from the NOMAD.

PERIODONTICS

P38 Association between Intra-Cranial Carotid Artery Calcifications and Periodontitis. A. ALSAKR*, S. BLANCHARD, P. WONG, T. THYVALIKAKATH, Y. HAMADA (Indiana University School of Dentistry)

Background: Ischemic strokes are the third leading cause of death in the US, of which calcified atherosclerotic plaques are a main risk factor. Recently, cone beam computed tomography (CBCT) is being utilized as part of periodontal and implant treatment planning. However, it should also be noted that intracranial carotid artery calcifications (ICAC) can be detected on CBCT images. Earlier detection of ICACs with subsequent notification to patients and their primary care physicians may be beneficial in the prevention and management of future ischemic strokes. Objective: The aim of this retrospective study was to examine the prevalence of ICACs on CBCT images and the association of n ICACs with age, gender, periodontitis, and cardiovascular diseases. Materials and Methods: Following the institutional board review approval, CBCT scans from a six-year period (2012-2018) were retrospectively reviewed. The presence or absence of ICACs were detected in each scan in the cavernous segments by a calibrated oral radiologist. Patient demographic data including age, gender, and the medical history specifically focused on cardiovascular diseases such as high blood pressure (HTN) and hyperlipidemia (HDL) were recorded. The presence or absence of periodontitis was recorded from each subject for data analysis. Correlations between ICAC and the patient's data were calculated to identify the odds ratio (OR). Results: A total of 208 subjects with ages ranging from 33-95 years old met inclusion criteria. Overall, ICACs were found in 93 subjects (45%). There were statistically significant associations between ICACs and the presence of periodontitis (OR=4.55), HTN (OR=3.02), HDL (OR=2.87), increasing age (OR=2.24), and male gender (OR=1.85). Conclusion: This study revealed that nearly half of the subjects showed intracranial carotid artery calcifications on CBCT images. These calcifications were significantly related to the status of the presence of chronic periodontitis, age, gender, and cardiovascular diseases. A more careful review of CBCT scans is highly recommended to detect these calcifications and refer patients for further medical evaluation.

P39 Screening for the Undiagnosed Diabetes Mellitus in a Dental School. S. AZAR*, S. BLANCHARD, V. JOHN, D. SHIN, Y. HAMADA (Indiana University School of Dentistry)

The aim of this study was to identify the number of diabetic patients that presented to the dental school clinics unaware of their diabetic condition and to examine any factors which may have associations between undiagnosed diabetes and patient characteristics. All subjects were recruited from the existing patient pool at Indiana University School of Dentistry. After the consenting process, the subjects were screened with the Point of Care Test via chair side finger-stick glucose test which provided an HbA1C score. Any subjects with an HbA1C score of ≤5.6% were assigned to the "possibly normal" category, 5.7-6.4% were assigned to the "possibly pre-diabetes" category while ≥6.5% were assigned to the "possibly diabetic" category. Patient demographic data including age, gender, race, BMI, presence or absence of medical insurance, smoking status, and periodontal diseases conditions were recorded. A total of 93 subjects have been recruited to date and 91 subjects with ages ranging 30-87 (53.59±13.7) years old met the inclusion criteria. A total of 6 subjects (6.8%) of subjects were categorized as "possibly diabetic" and the average HbA1c was 7.03 ±0.33% (Range: 6.6-7.4). A total of 14 subjects (15.4%) of subjects fit in "possibly pre-diabetes" and the average HbA1c was 6.01 ±0.27%. All subjects whose HbA1c was ≥5.7% were referred to their physicians for accurate diagnosis and treatment. This study

showed that 23.1% of the patients initially screened in a dental school setting who are not aware their diabetic conditions showed HbA1c values ≥5.7%. Of patients with screening values >5.7, a mean average of 56% presented with presence of periodontitis while patients with HbA1c values ≥5.7% presented with periodontitis a mean average 28.4% of the time. Screening for diabetic conditions at dental offices can provide significant benefit to patients as it will allow earlier referral to medical teams for further evaluation and interventional treatment.

P40 Effects of Antibacterial Agents on Oral Bacteria and Gingival Fibroblasts. C. BATRA*, M. ALALSHAIKH, A.A. AZABI, R.L. GREGORY, L.J WINDSOR, S.B. BLANCHARD, Y. HAMADA (Indiana University School of Dentistry)

The study objectives were: 1) to compare the anti-bacterial efficacies of 0.12% chlorhexidine di- gluconate (CHX), 10% povidone-iodine (PVD), antioxidant gel (AO) and herb based gel (HG) on *Streptococcus mutans (S.m)*, *Streptococcus sanguis (S.s)*, *Fusobacterium nucleatum (F.n)* and *Porphyromonas gingivalis (P.g)* with and without the effect of nicotine; and 2) to evaluate the effects of these agents on human gingival fibroblasts (HGFs). *S.m*, *S.s*, *P.g* and *F.n* were incubated with different dilutions of the anti-bacterial agents in culture media (with and without 2 mg/ml of nicotine). Minimum inhibitory and minimum bactericidal concentrations were calculated using a spectrophotometer (595 nm) and blood agar plates. Water-soluble tetrazolium- 1 (WST-1) and lactate dehydrogenase (LDH) assays were used to measure the proliferation and cytotoxicity of these agents on HGFs, respectively. CHX and PVD significantly inhibited the growth of the two streptococcal species ($p<0.05$) at all dilutions. AO and HG inhibited streptococcal growth with higher concentrations (>12.5%). CHX and PVD significantly inhibited the growth of *P.g* and *F.n* at all concentrations. Whereas, AO and HG inhibited the growth of the two anaerobes up to a 3.1% concentration. Exposure to lower concentrations of CHX (<0.00012%) did not significantly affect HGF proliferation. PVD at 1, 0.1, 0.01 and 0.001% significantly affected cell proliferation and was toxic at 1% and 0.1%. AO affected HGF proliferation and was toxic at all concentrations. HG did not significantly affect HGF proliferation and demonstrated no significant cytotoxicity. CHX and PDV displayed antibacterial properties, however they significantly reduced HGF proliferation at higher concentrations. AO reduced bacterial growth but was toxic to HGFs. HG demonstrated antibacterial effects comparable to CHX and PVD with higher concentrations and demonstrated no effects on HGF's. These results may be extrapolated for developing post-surgical protocols for periodontal mucogingival procedures.

P41 Assessing Heat Generation during Implantoplasty with Variable Irrigation Flow Rates. J. CHANG*, T.M. CHU, S. SOCHACKI, S. BLANCHARD, C. BARCO, Y. HAMADA (Indiana University School of Dentistry)

Rough surface implants may play a role in the incidence of peri-implantitis by harboring bacterial plaque once exposed to the oral cavity. Implantoplasty suggests decontaminating the exposed implant surface by smoothing threads and theoretically removing the outermost contaminated layer of titanium. Concerns regarding implantoplasty include damage to surrounding bone due to excess heat generation. The aim of this study was to assess the heat generation change in peri-implant bone during implantoplasty procedures using different flow rates of irrigation. Bovine bones were sectioned into 10 mm blocks with 2 mm of cortical thickness at the coronal aspect. A total of 27 bovine rib bone samples were prepared. Engage® bone level 3.25 x 8 mm implants were placed a depth of 4 mm. The remaining 4 mm of the implant surface were exposed to imitate peri-implantitis conditions. Each bone block was randomly assigned to one of 3 experimental groups according to irrigation flow rate (5, 25, 40 ml/min) and implantoplasty was performed. Peri-implant bone temperature was measured for each implant at crestal and lateral positions. The maximum increase in temperature based on irrigation flow rate and time from maximum to baseline temperature were measured and analyzed. Results showed that irrigation flow rate of 5ml/min produced statistically significant higher temperature change and longer times to return to baseline temperature compared to 25 or 40 ml/min flow rates, specifically at the crestal location ($20.49 \pm 7.40°$, $P < 0.05$). There were no statistically significant differences to temperature change or time from maximum to baseline temperature with either 25 or 40 ml/min flow rates. Within the limitations of this study, the results suggest that low irrigation flow rates can attribute to damaging heat generation, and an irrigation flow rate of at least 25 ml/min is recommended for implantoplasty procedures.

PRACTICE MANAGEMENT / PUBLIC HEALTH

P42 **Sociodemographic and Behavioral Influences on Oral Health in Saudi Arabia.** N. ABOGAZALAH*[1], C. T. YIANNOUTSOS[2], J. F. YEPES[1], A. SOTO[1], E. A. MARTINEZ-MIER[1] ([1]Indiana University School of Dentistry, [2]R.M. Fairbanks School of Public Health Indiana University-Purdue University Indianapolis)

Objective: The study aimed at describing and analyzing the direct and indirect influences on oral health, as reported in the 2017 national Demographic and Health Survey (DHS) in the Kingdom of Saudi Arabia (KSA) utilizing a conceptual framework model. Methods: Secondary data analysis of the DHS, KSA 2017. Our conceptual model depicted oral health influences as indirect and direct influences. Indirect influences were: Sociodemographic determinants– age, gender, marital status, nationality, region, education, and socioeconomic status; Environmental determinants– physical safety, water source, and resident characteristics; Health system and services– dental health care availability, source of care, and state of insurance; General health behavior– physical work and exercise, and self-care behavior; General health status– physical disability, morbidity, and mental health; Direct influences were: Use of oral health services– dental visits frequency and type of visit; Oral health risk behavior– oral hygiene, diet, and smoking. The study's outcome variables were self-reported oral health status and dental pain experience. The data analyses included population characteristics and prevalence of oral influences. For categorical variables, frequency distributions and relative frequencies were calculated. Means and/or medians were calculated for continuous variables. Results: eligible survey respondents were N=56,539. The largest age group was 25-35 years old (19.8%). More females (54%) respondents than males (46%). Twenty-six percent of the population reported they were not able to obtain dental treatment when needed; while 9.4 % reported they had never been to a dentist. The most common reason for their last dental visit was dental pain (68.2%). Only 14.9 % of the population brushed their teeth twice or more daily. Finally, 57.9% of the population reported feeling pain at least once in the past year. Within the limitations of this study, the KSA population is in need for oral health promotion programs to improve oral hygiene practices and regular dental checkups.

P43 **Impact of Location on dmft Scores in Medicaid Patient Population.** R. MINHAS*, A.JOSHI, A. SCULLY (Hoosier Pediatric Dental Group and Indiana University School of Dentistry)

Purpose: The aim of the study is to compare the dmft scores of patients with Medicaid insurance in rural and suburban location of a private practice office and analyze if location plays a significant role in the dmft scores. Methods: A total of 200 patients, 100 each from the suburban office (Fishers) and rural office (Marion) of Hoosier Pediatric Dental Group were selected by a stratified random sample based on the alphabet of the last name. Inclusion criteria for chart selection were if the child is on Medicaid insurance, is 0 to 5 years old, is an ASA 1 patient. Charts were excluded if the child was not on Medicaid, older than 5 years old, and was not an ASA 1 patient. The dmft scores of children with Medicaid aged 0 to 5 were collected from the Fishers and Marion Offices from the year 2017 to 2020. Statistical analysis was completed using descriptive statistics, unpaired t-test using equal variance and chi square analysis. Result: A total of 200 charts, out of which 58 were males and 42 were females from each office. The Marion office has 54 White, 24 were Hispanic, and 21 other races. The Fishers office had 68 White, 14 were Hispanic, and 18 other races. The maximum dmft score in Marion office was 15 and the minimum was 0. The maximum dmft score in Fishers office was 14 and the minimum was 0. The average dmft in the Marion office was 3.18 ± 4.43 and in the Fishers office it was 1.59 ± 3.39. Statistical testing showed that there was a significant difference between the races at the two locations (p=0.003) and the dmft scores (p=0.005). Conclusion: Practice location may play a role in dmft scores when comparing rural and suburban locations, however the distributions of races were also different between the two populations.

PROSTHODONTICS

P44 **Novel Guided Surgical Template Design with Irrigation Channel.** A. ORGEV*[1], W.S. LIN[1], W.C. MARTIN[2], D. MORTON[1] ([1]Indiana University School of Dentistry, [2]University of Florida College of Dentistry)

Background: Surgical placement of dental implants is a delicate procedure which could achieve more predictable and accurate result by using surgical templates to follow restorative plan. Increased use of technology in dental implantology allows clinicians to benefit from the improvements in time efficiency, predictability results in less

morbidity of patient and result in better comfort. Although guided implant site preparation demonstrates increase predictability and accuracy, it is not free from risk of complications. Guided preparation of the future implant site becomes more precise with guided surgery which results in more friction between the drill and metal parts in the template and eventually within the bone drill surface. In the recent years, over-heating of the bone due to guided implant surgery is started to be evaluated by several researchers. Although there are various ways demonstrated in the literature to improve efficiency of cooling during implant site preparation, none to our knowledge had demonstrated additional design implemented to the surgical template design. Treatment: This clinical report focuses on novel design for more effective irrigation during implant site preparation for cooling. Digital implant planning is completed for implant for #5 with restorative plan in software with addition of fixation pin during the template designing phase to point out the future implant and cortical bone connection region. This design allows the irrigation solution to be directed to the critical area of heat generation. It is demonstrated clinically that this novel design is more effective regardless of visibility and access issues to the site for irrigation solution to reach to the critical heat generation site during implant site preparation. Conclusion: Considering the simplicity of the designing during the planning phase, clinical experience demonstrated time saving and more efficient workflow for guided implant site preparation.

P45 Accuracy of Intaglio Fit of Conventional and CAD-CAM Obturator Prosthesis. A. ALFARAJ*, J. LEVON, D. MORTON, W.S. LIN (Indiana University School of Dentistry)

No studies have been reported on the accuracy of denture base on the CAD-CAM obturator prosthesis. The purpose of this study is to investigate accuracy of intaglio fit of conventional and CAD-CAM obturator prosthesis. A patient master cast with a palatal defect was used for the purpose of this report. 4 stone study casts were duplicated from the master cast and each one was randomly assigned to a denture processing method. Cast A (pack and press technique), Cast B (injection molded technique), Cast C (milled technique) and Cast D (printed technique). CAD-CAM group was fabricated each from a separate scan of the stone study cast and the same master cast digital design was applied. For the conventional group the same process was repeated but was milled in wax and readapted to the corresponding study casts and processed accordingly to corresponding processing technique. A laboratory scanner was used to scan each obturator prosthesis's intaglio surface, and a CAD-CAM software program was used to superimpose the STL files from the obturator prosthesis' intaglio surfaces and their corresponding study casts. This software calculated all possible locations between 2 STL files, and 1 final alignment with best object-to object penetration was determined. Dimensional variances among virtual study casts and the intaglio surfaces of resulting obturator prosthesis was computed, and the mean deviation root mean square (RMS, measured in mm) was used to estimate the consistency of 2 superimposed STL files. Summary statistics was calculated for RMS for each of the 4 samples. The results showed differences between different techniques with RMS reported for milling, printing, compression and injection techniques as follow: 1.1263mm, 0.3491mm, 1.1003mm, 0.8606mm. However, although results reflects that CAD-CAM techniques were promising as RMS values reflected in terms of accuracy and reproducibility, further investigation especially in terms of sample size is needed to have more definitive results.

P46 Comparison of Surgical Template Accuracy in Positioning and Removal Timing. M.E. MIRANDA-DELGADO*, F.Y. SU, W.S. LIN (Indiana University School of Dentistry)

The static computer-aided implant surgical planning increases the accuracy in surgical execution. The manufactured surgical template carries the planned information to the clinical application. Due to the possible differences in light intensity at different positions on the same LCD panel, printing object positioning influences the material polymerization. In regular dental practice, the surgical template fabrication may be initiated at the end of the day and to be removed from printing bed until the next day. Hence, the accuracy in surgical template fabrication via additive technology needs to be investigated. The objectives of the investigation: To evaluate the effect on surgical template with different timing of removal from printing bed. To evaluate the accuracy of the surgical template with different positioning on the printing bed. Experimental methods used: Additive manufacturing device (Phrozen Shuffle) was used in the study. The printing layer thickness was set at 100 microm per layer. The surgical template file in Standard Tessellation Language (STL) was oriented at 45-degree angulation with three different positions on the printing bed, which was right, middle and left. The surgical templates were removed from printing bed at the time of completion, after 2 hours, after 12 hours and after 24

hours. The fabricated surgical templates were scanned and the accuracy was compared to the original STL file in a surface matching software (GeoMagic Design X; 3D Systems Inc).

	Right	Center	Left
0 hr	0.1094	0.1346	0.13
2 hr	0.1082	0.1219	0.1019
12 hr	0.1237	0.1209	0.1195
24 hr	0.1216	0.1336	0.1215

Essential results: The RMS value obtained from mesh deviation measurement shows that all surgical templates are clinically acceptable. Removal after 24 hours show the most deviation among all groups. In STL file positioning, the center position shows the most deviation. Frequent use of positioning STL file in the center may cause inaccuracy.

SALIVARY RESEARCH

P47 Salivary Epithelial Cells Responses in Oral Lichen Planus. A. LINDSAY*, S. MUDUNURI, S. ZUNT, M. SRINIVASAN (Indiana University School of Dentistry)

Objective: Oral mucosal lesions (OML) constitute any abnormal alteration in color, surface aspect, swelling, or loss of integrity of the oral mucosal surface. OMLs such as lichen planus, periodontitis, pemphigus are chronic conditions that interfere with everyday quality of life. Inflammation is a major mechanistic contributor secondary to exaggerated immune response to the changing bacterial composition in the mucosal biofilm. The host response to microbes is mediated by activated pattern recognizing receptors called toll like receptors (TLR). Saliva is a rich source of exfoliated oral epithelial cells that act as microbial reservoirs. In erosive lichen planus (ELP), there is increased exfoliation of epithelial cells. Hence, we hypothesized that the TLR and inflammatory profile of salivary epithelial cells in erosive lichen planus could provide customized assessment of the host: microbial response. Methods: Archived unstimulated whole saliva and the associated salivary epithelial cells from twenty healthy and clinical ELP individuals were obtained. The human TLR mRNA profiler array was used to determine the responsiveness of the salivary epithelial cells in each cohort. Data was confirmed by quantitative real time PCR of select TLRs and ELISA for select cytokines. Results: The profiler data suggest that the TLRs 2, 5, 8, 9 and 10 were significantly upregulated in the salivary epithelial cells of ELP patients. The proinflammatory cytokines IL-6 and TNF-a were higher in the clarified saliva of ELP individuals as compared with the healthy controls. The associated transcription factors MYD88 and IRAK1 were also elevated. Conclusion: The salivary epithelial cells in ELP could represent a biospecimen for assessing the host response in real time.

TISSUE REGENERATION AND REPAIR

P48 RANKL-Independent Osteoclastogenesis in SH3BP2 Cherubism Mice. M.E. LEVITAN*[1,2], M. KITTAKA[1,2], T. YOSHIMOTO[1,2], H. HOFFMAN[3], Y. UEKI[1,2] ([1]Indiana University School of Dentistry, [2]Indiana Center for Musculoskeletal Health Indiana University School of Medicine, [3]University of Missouri-Kansas City, School of Dentistry)

Osteoclasts are exclusive cells responsible for bone resorption in our bodies. The receptor activator of the nuclear factor-κB ligand (RANKL) and its receptor, RANK, are essential for osteoclastogenesis. The disturbance of the RANKL-RANK signaling results in severe osteopetrosis due to a lack of osteoclast formation. Gain-of-function mutations of SH3-domain-binding protein 2 (SH3BP2), which are causal mutations for a human craniofacial disorder cherubism, enhance the induction of osteoclasts and their activity. Previously we created the mouse model of cherubism by knocking the most common mutation into mice (*Sh3bp2*$^{KI/KI}$). Here, we report that cherubism mice develop functional osteoclasts independent of RANKL. *Sh3bp2*$^{KI/+}$ and *Rankl*$^{+/-}$ mice were used to create double-mutant mice (*Sh3bp2*$^{KI/KI}$*Rankl*$^{-/-}$). Bone volume/tissue volume ratio (BV/TV) of trabecular bone on femur was measured using Skyscan 1176 µCT. Femora were decalcified, paraffin-embedded, sectioned and subjected to H&E and TRAP staining. The number of TRAP+ cells underneath the growth plate of the distal end of the femur was measured by Bioquant. The BV/TV for wild-type, *Rankl*$^{-/-}$, and *Sh3bp2*$^{KI/KI}$ *Rankl*$^{-/-}$ mice was 2.66 ± 2.10%, 93.86 ± 3.58%, and 86.55 ± 6.50% for male and 1.82 ± 1.08%, 96.30 ± 3.54%, and 78.98 ± 15.80%

for female, respectively. Although *Sh3bp2*$^{KI/KI}$ *Rankl*$^{-/-}$ mice exhibited osteopetrotic phenotype with much higher BV/TV than *Sh3bp2*$^{+/+}$ mice, *Sh3bp2*$^{KI/KI}$*Rankl*$^{-/-}$ mice showed lower BV/TV than *Rankl*$^{-/-}$ mice by 7.8% for male and 18.0% for female. TRAP staining showed TRAP-positive osteoclasts on the bone surface of the femur in *Sh3bp2*$^{KI/KI}$ *Rankl*$^{-/-}$ mice, although the number was much less than that of *Sh3bp2*$^{+/+}$ mice. Both *Sh3bp2*$^{+/+}$ and *Sh3bp2*$^{KI/KI}$ *Rankl*$^{-/-}$ mice showed that more osteoclasts are induced near the growth plate. In conclusion, cherubism mice with a gain-of-function mutation in the *Sh3bp2* gene develop osteoclasts even in the absence of RANKL and the cherubism mutation improves osteopetrosis in *Rankl*$^{-/-}$ mice.

Clinical Case Report Presentations

DENTAL HYGIENE

CC1 Care Strategies for an Intellectually Disabled Patient with Chronic Diseases. A. BENBOW*, A. FOSTER, P. RETTIG (Indiana University School of Dentistry)

Objective: This case study presentation discusses strategies of care for an intellectually disabled patient with multiple chronic diseases. Assessment: A forty-two year old adult presents to the dental hygiene clinic as a new patient. The patient had previously been seen in private practice for regular 6-month prophylaxis recalls. The medical history reveals mild mental retardation and cognitive impairment, Crohn's disease, diabetes mellitus type 2, hyperlipidemia, hypertension, and an allergy to penicillin. Six of the seven medications that the patient is currently on have dental effects. The patient presents with generalized plaque induced and non-plaque induced gingivitis as evidence by dark pink, rolled margins, soft tissue, 37% plaque score, and bleeding on probing with localized chronic periodontitis as evidence by 4mm clinical attachment levels due to inflammation. The patient reports brushing once a day and never flossing or using a mouth rinse. It was determined that the patient had a high caries risk due to recent caries, oral habits, current medications, and diet. Dental Hygiene Care Plan: The patient received an adult prophylaxis, oral hygiene instruction, and a fluoride treatment. Modifications involved: communication with the caregivers before and during the appointment, simplifying speech towards the patient, explaining details more thoroughly, increasing rinses, reducing distractions, and listening carefully. Evaluation: Patient will brush twice a day, floss once a day, rinse once a day, and maintain 6-month prophylaxis recalls with assistance and supervision of caregivers. Conclusions: All dental health professionals should be aware of care strategies for these patients through communication, collaboration, and coordination.

CC2 Access to Dental Care for Patients in Home Care Facilities. M. BOYER*, A. NEFF, H. BUTLER, T. RADER (Indiana University School of Dentistry)

Access to dental care for patients in home care facilities remains an ongoing challenge. Many of these individuals range from senior citizens to those with special needs, which may render them reliant on others for their daily, as well as routine, oral hygiene care. Although many facilities provide transportation to dental offices, some residents are unable to be transported due to certain conditions, so they are not receiving the dental care they need and deserve. Fortunately, Indiana passed House Bill 1116 in March of 2018, allowing hygienists to work unsupervised, performing oral care procedures in places such as home care facilities, so long as a practice act agreement is in contract with a dentist. This collaboration has the potential to bring oral health back into these facilities, where periodontal disease, tooth decay and emergency dental situations are all too common. Our objective is to raise awareness of this practice act agreement and to explain the process to dental professionals, so that they will ultimately take part in this oral health care advantage. Additionally, we will recommend ways for home care facilities themselves to train their staff on providing basic daily oral hygiene care to their residents that will promote oral health between visits from a hygienist. Few facilities have resourced this additional training to provide daily teeth brushing and oral checks to their residents, making the demand for more capable facilities crucial. In conclusion, we hope to educate dental professionals and beyond of House Bill 1116 and bring awareness in hopes to instill this collaboration into their dental practice. We would also like to promote more training being provided to the facilities care providers on basic daily oral hygiene for patients to initiate overall improved health among patients, leading to decreased need for restorative, periodontal, and emergency dental care.

CC3 Management of the Narcoleptic Patient in the Dental Setting. M. ELLIOTT*, L. ADAMS, L. MAXWELL (Indiana University School of Dentistry)

Objective: Discuss the management and treatment indications of patients with narcolepsy and associated symptoms during dental appointments. Assessment: A 72-year-old male presents to the Dental Hygiene Clinic for periodontal maintenance and an exam with a medical history positive for narcolepsy with associated sleep paralysis. He reports experiencing narcoleptic episodes in the dental setting, with the last occurrence being in March of 2016. Background: Narcolepsy is a condition characterized by an extreme tendency to fall asleep whenever found in relaxed surroundings. Narcoleptic episodes are generally triggered when patients are in a state of rest, such as during a dental visit when a patient is laying supine for an extended period of time. Thus, it is imperative that dental professionals know how to manage patients that are having a narcoleptic episode. Further, it is beneficial for the dental professional to learn how to educate the patient on home care strategies that may combat the symptoms of xerostomia, bruxism, and grinding, which are common side effects of narcolepsy medications. Conclusion: Interventions such as appropriate home care, active communication, and use of a bite block during treatment are approaches that would aid in successful treatment.

CC4 When to Treatment Plan with 4355 for Nonsurgical Periodontal Therapy. C. HURST*, P. MEADORS, L. MAXWELL (Indiana University School of Dentistry)

Patient presented to the dental hygiene clinic for an initial appointment with the dental hygiene student. Patient indicated he had no dental home for the past nine years. Intra-oral evaluation revealed generalized heavy subgingival and moderate supragingival calculus and generalized heavy tobacco stain. Radiographs revealed generalized interproximal calculus with generalized mild bone loss as evidenced by 3-4 mm from CEJ to crest of bone with localized severe bone loss as evidenced by 7+ mm from CEJ to crest of bone on #2, #3, and #14. The use of code D4355 was suggested due to the 2- and 3-mm CAL levels found during periodontal assessment being inconsistent with the 7mm measurement on the radiograph at this site. The student was having difficulty recording accurate probing depths during the assessment which led to the discussion of treatment planning for D4355 then have the patient reappoint one week later for periodontal assessment and treatment planning. Differing opinions were expressed among two faculty members and the student during treatment planning regarding the use of the D4355 Full Mouth Debridement (FMD) code. Results: The treatment proceeded with the exclusion of D4355 prior to implementation of non-surgical periodontal therapy (NSPT). Conclusion: Due to the lack of understanding surrounding the D4355 code and the ambiguity of the CDT definition of the D4355 leads to misunderstanding among dental professionals and lack of usage of the code in general.

CC5 Modifications of Dental Hygiene Care in a Cerebral Palsy Patient. A. LINDSEY*, M. LINDVALL, A. RIECK (Indiana University School of Dentistry)

Cerebral palsy is a group of disorders that affect movement and muscle tone or posture due to damage that has occurred in the immature brain and is usually diagnosed during childhood. The objective of this clinical case presentation is to identify modifications that may be indicated in the dental hygiene treatment plan and patient education of an adult patient with Cerebral Palsy (CP). A geriatric, wheelchair-bound patient with cerebral palsy presented to the dental hygiene clinic for their first prophylaxis in three years. The medical history revealed she was diagnosed with CP at birth. The patients muscle movements were limited due to stiffness and some spasticity. To provide optimal care, modifications were made to the dental hygiene care plan. These modifications included standing dentistry, reconfiguration of the dental unit to allow room for the wheelchair, and additional safety precautions to protect the patient from potential injury due to sudden movements or seizures. In addition, the patient's home care was lacking as evidenced by generalized gingivitis and moderate calculus deposits. Due to these findings, the patient was shown modified oral hygiene instructions. These modifications included alterations to how they held their electric toothbrush and WaterPik to accommodate the limited dexterity. Additionally, the patient was instructed on how to position their motorized wheelchair over the sink to aid in expectoration. Dental hygienists could possibly encounter a patient with CP sometime in their career, so it is important for them to know how to modify treatment as indicated. Patients who present with CP may require modifications in dental care and education based on the severity of their condition, and dental hygienists could benefit from learning from modifications introduced in this particular case.

CC6 Patient Management with Hard Palate Removal. N. NAAMAN*, A. RUSSELL, T. RADER (Indiana University School of Dentistry)

The intent of this case presentation is to analyze the importance of how to effectively manage an oral cavity that has experienced palatal removal. Multiple problems can arise from a resected palate such as; difficulty with chewing, swallowing, speaking, malocclusion, and deficiency in tissue and supporting structures. An eighty-year-old, Caucasian male presented to the Dental Hygiene clinic for a sixth month recall appointment. The medical history displays a history of atrial fibrillation, hard palate cancer, chronic obstructive pulmonary disease, gastroesophageal reflux disease, hyperlipidemia, hypertension, and impaired hearing. With that being said, most of the seventeen medications he has been prescribed, have some sort of dental effect. Patient reported having some concern with his obturator and supporting structures due to a bloody nose. He states his oral routine consists of brushing a minimum of two times a day for a minute, incorporating mouthwash throughout the day (preferably after meals), and uses wax floss daily. Clinical Assessment: The patient presents with mild periodontitis as evidenced by 4-6mm clinical attachment levels. Radiographically, there was generalized bone loss as evidenced by 3-5mm cemento-enamel junction to crest of bone. The patient also presents with generalized plaque induced papillary gingivitis as evidenced by dark pink, spongy, rolled gingiva with generalized bleeding on probing. Multiple modifications were made to accommodate the patient such as; not fully reclining the patient, sitting him up during rinse and suction, having my mask down to communicate, and he would frequently plug nose to sound clearer. The patient received a prophylaxis and oral hygiene instructions. Many dental concerns can arise from a resected palate and is it important for dental professionals to be able to manage these patients in order to provide appropriate treatment and care.

CC7 Management of the Visually Impaired Patient. E. PEDIGO*, P. CLEMONS, T. RADER (Indiana University School of Dentistry)

Our objective is to give insight and education to dental professionals on the management of treating visually impaired patients when in the dental setting. A male patient presented to the dental hygiene clinic at IUSD who happened to be completely blind. This patient was diagnosed with glaucoma which eventually led to his complete loss of vision. This patient required many modifications in the DH care plan in order to successfully provide optimal care. At the beginning of the appointment, the patient required guidance to the chair. Throughout the appointment, procedures needed to be explained in great detail so the patient was aware of what we were doing and how it was going to feel. We need to provide the patient with a picture in his mind because he is unable to see. Oral hygiene instruction was a portion of the appointment that required an extensive description provided to the patient. Because the patient has not been blind his whole life, he does know about oral hygiene aids and his dentition, but descriptive words were key at this point. Brushing and flossing techniques were told in great detail to the patient and then demonstrated in the patient's mouth while the patient was able to feel what was happening. We are bringing this case up because at some point, dental professions have or will be treating patients who are visually impaired. According to the CDC, “more than 3% of Americans aged 40 years and older are either legally blind or visually impaired” (*CDC,* 2009). We are presenting our case on the visually impaired patient because dental professionals have or will be in contact with this type of special needs patient at some point in their career. We would like to share our previous experiences with these patients in order to help professionals prepare and give the best care possible.

CC8 Factors Affecting Oral Care in Spanish Native Speaking Patients. S. SANTOS*, D. COOPER, P. RETTIG (Indiana University School of Dentistry)

Objective: To educate the dental profession on the importance of language in accessing dental care. Assessment: A 52 year old Spanish speaking Hispanic female presented to the Dental Hygiene Clinic as a new patient to IUSD with a chief complaint of “I need my teeth cleaned.” The patient stated that she had not visited a dental office in the past ten years. Medical history revealed a history of medication for type two diabetes. The patient presented with generalized diffuse gingivitis evidenced by red, spongy, and bulbous papilla with a bleeding index of 100%. The periodontal description revealed generalized mild to moderate periodontitis as evidenced by 4mm- 6mm CAL. The patient presented with localized mild bone loss as evidenced by 3-4mm from CEJ to crest of bone on 3, 14, and 29 and localized moderate bone loss by 5-6mm from CEJ to crest of bone on 7,8,9,10,24, and 25. The patient’s plaque score ranged from 36% to 62% and generalized moderate to heavy supragingival and subgingival

calculus was detected. DH Care Plan Included: Patient received scaling and root planning utilizing hand and power Instrumentation, tissue reevaluation, individualized oral hygiene instructions in her native language, and prescription of Peridex. Evaluation: After the tissue evaluation, it was determined that scaling and root planning was unsuccessful due to patient still having active infection evidenced by no decrease bleeding on probing or periodontal pocket depth. Conclusion: It is critical for the patient to understand all aspects of homecare in their native language to ensure optimal patient compliance and successful treatment.

CC9 Identification of Causes, Symptoms, and Treatment of Tonsil Stones. C. WALKER*, H. DEAN, T. RADER (Indiana University School of Dentistry)

Tonsillar stones are the result of microorganisms and cellular debris retained and calcified in the palatine tonsils. The objective of this study is to identify the symptoms, determine the causes, and assess possible treatment of tonsil stones. We present the case of a 52 year-old man with recurrent sinusitis and sore throat over a long period of time. Patient reported having frequent halitosis. Upon examination, the patient presented with a 2mm by 1mm white tonsil stone in his right tonsil. Upon further research, we determined the underlying causes of tonsil stones to include microorganisms, debris, and saliva. In order to treat and avoid tonsil stones, the bacteria in the oral cavity must be reduced. The results of this research suggest that tonsil stones are caused by trapped debris combined with the accumulation of sulfur-producing bacteria and saliva that results in bad breath, visible stones, and throat irritation.

ENDODONTICS

CC10 The Power of Endodontics: Trust Your Testing. A. BROADY*, K. SPOLNIK, J. BRINGAS, Y. EHRLICH (Indiana University School of Dentistry)

Introduction: Periapical bone resorption, which on a radiograph can be identified as a radiolucency, is an important diagnostic feature of apical periodontitis. Because intraradicular microorganisms are usually associated with and implicated as the primary etiologic agents of apical periodontitis, root canal treatment is aimed at eliminating infection. When the treatment is done properly, healing of the periapical lesion usually occurs with osseous regeneration. If the root canal treatment fails, the periapical lesion may persist and/or grow and encompass neighboring teeth. In this scenario, endodontic testing becomes crucial to identify the offending tooth. Methods: A 28-year-old, asymptomatic, male presented to IUSD for evaluation and CBCT of left mandible after dentist noted incidental finding of a large periapical radiolucency in the left mandible spanning from tooth #18 to #20. Endodontic testing revealed normal responses from all teeth in lower left quadrant. An incisional biopsy determined the lesion to be a periapical granuloma. Nonsurgical endodontic retreatment of tooth #18 was performed. Conclusion: One must not rely on radiographs alone to develop a diagnosis but on full clinical and radiographic exams, including endodontic testing.

CC11 Central Giant Cell Granuloma: A Case Report. B.FISCHER*, K. SPOLNIK, J. BRINGAS, Y. EHRLICH (Indiana University School of Dentistry)

Introduction: Central Giant Cell Granuloma (CGCG) is a rare, benign, proliferative, intraosseous lesion of unknown etiology commonly thought to be nonneoplastic. Treatment often includes orthograde endodontic treatment and surgical intervention with thorough curettage. This report presents the surgical treatment of a central giant cell granuloma in the operating room following nonsurgical endodontic treatment of teeth #24, 25, 26. Methods: A 12-year-old female patient presents to the OR for root end surgery #25 and enucleation of large mandibular lesion. Root end surgery #25, enucleation of lesion, placement of platelet rich fibrin (PRF) with DFDBA, calcium sulfate and DynaMatrix were completed. Results: Following treatment, area healed well and the patient has been asymptomatic with no evidence of recurrence. Conclusion: Treatment of CGCG requires surgical intervention in addition to orthograde endodontic treatment. These cases should be monitored over time due to the relatively high recurrence rate of CGCG.

CC12 5-year Follow-up of Surgical Management of Bilateral Periodontal Lesions. K. PAULY*, K. SPOLNIK, J. BRINGAS, Y. EHRLICH (Indiana University School of Dentistry)

Introduction: The goal of nonsurgical root canal therapy is to reduce the bacterial load within an infected root canal system, and subsequently, to increase bone healing of the periapical lesion associated with apical periodontitis. Periradicular actinomycosis is one of the most common reasons for the failure of nonsurgical endodontic treatment and retreatment. If a tooth is nonresponsive to nonsurgical endodontic treatment, apical actinomycotic infection should be suspected and a surgical approach should be planned to obtain a successful outcome. This report presents the surgical treatment of bilateral epithelial lined cysts, one associated with actinomyces bacterial species, in the anterior maxillofacial region. Methods: A 16-year-old female patient presented to IUSD Graduate Endodontics. Clinical and radiographic testing revealed apical lesions associated with #7 and #10. Both teeth were treated endodontically with non-surgical root canal therapy. Periapical lesions did not resolve, and apical root end surgery was performed. Apical specimens were biopsied and sent for histopathological evaluation. Results: At 5-year and 1-year follow-up, patient was still symptom free and bone healing was nearly completed. Conclusion: An epithelial lined granulation cyst with bacterial colonies morphologically consistent with actinomyces species and an epithelial lined granulation tissue abscess can successfully be treated with apical root end surgery.

CC13 Management of an Endodontic Infection in a Medically Compromised Patient. T. SHIREMAN*, Y. EHRLICH, N. WARNER (Indiana University School of Dentistry)

Objective: The pulp of teeth with intact crowns and with no obvious bacterial portal of entry can become infected and require root canal treatment (RCT). A single visit endodontic treatment of an endodontically infected tooth #6 with an intact crown in a medically compromised patient is discussed. Case: 55-year-old male was referred to IUSD Undergraduate Endodontic Clinic for endodontic diagnosis and treatment. Patient was referred from Eskanazi Hospital after being successfully treated for a facial swelling of dental origin with antibiotics. Patient's medical history included diabetes, hypertension and a right prosthetic leg due to a work injury. The patient was taking: Gabapentin, Insulin, and Lisinopril. Prophylactic Amoxicillin was recommended prior to dental treatment. Tooth #6 had an intact crown with grayish discoloration and did not respond to cold or electric pulp testing. Percussion and palpation testing were negative. The x-ray showed a widening of the apical lamina dura (PDL). The endodontic diagnosis was pulpal necrosis with asymptomatic apical periodontitis #6 was determined to be the offending tooth. After access the pulp was found to be necrotic. The canal was shaped with hand files and Profile rotary files to size #30.04. The canal was irrigated with sodium hypochlorite (6%) and chlorhexidine (2%). Both irrigants were agitated with an *Endo Activator*™. Obturation was done with cold lateral condensation and Grossman's sealer. The access was sealed with glass ionomer resin. Discussion: Infection of teeth with intact crowns is known and the microbial portal of entry is through micro-cracks. The RCT was done in a single visit (SV). SV treatment can be as successful as multiple visit. This was the treatment of choice due to the risk of poor patient compliance with a second visit. Conclusion: Single visit RCT of an infected tooth with an intact crown in a disadvantaged medically compromised patient was presented.

ORTHODONTICS / IMAGING / CRANIOFACIAL

CC14 Treatment of Peg-shaped Maxillary Lateral Incisors: A Case Study. S. BUEDEL*, J.I. WATSON, D.A. ALBRIGHT, K.T. STEWART (Indiana University School of Dentistry)

Background: The presence of developmental dental anomalies often results in unesthetic alterations to the size and shape of affected teeth and a compromise in overall smile esthetics. Peg-laterals are a form of microdontia in which the maxillary lateral incisors appear under-sized, tapered or cone-shaped. Treatment of peg-laterals typically includes a combination of orthodontic and restorative treatment. Orthodontic treatment allows for improvement in the alignment and position of the teeth (miniesthetics); whereas, restorative treatment allows for improvement in the size, shape and contour of the teeth (microesthetics). One option for restorative treatment is placement of resin-composite restorations via direct bonding, a quick and conservative treatment method in which resin-composite material is added directly to the tooth surface. Direct bonding provides an excellent esthetic option with adequate restorative longevity, especially in adolescent patients, for whom placement of porcelain veneers or other restorative options are often contraindicated until the cessation of growth. Patient Background: An 11-

year-old Hispanic female presented with a Class II Division II malocclusion, excessive overbite, mild crowding in maxillary and mandibular arches, as well as compromised smile microesthetics due to the presence of a peg-lateral (tooth #7) and a discolored maxillary left central incisor (tooth #9). Orthodontic treatment was completed in 22 months. A Class I occlusion and ideal overbite were achieved and crowding was eliminated to provide an improvement in overall alignment. Following orthodontic treatment, in-office and at-home bleaching were conducted to improve the overall shade of the teeth. Subsequently, direct resin-composite restorations were placed on teeth #7 and #9, resulting in a dramatic improvement in the patient's smile microesthetics. Conclusion: Comprehensive orthodontic treatment, in conjunction with dental bleaching and placement of resin-composite restorations via direct bonding, provided satisfactory treatment outcomes for an adolescent patient presenting with compromised smile esthetics due to the presence of a developmental dental anomaly.

CC15 Consequences of Uncontrolled Orthodontic Tooth Movement: Case Report. J. DEEK*, K.T. STEWART (Indiana University School of Dentistry)

Background: Meticulous diagnosis and treatment planning in orthodontics is critical to achieving an esthetic and functional outcome. Various mechanical principles and strategies exist that can be incorporated into contemporary treatment modalities. However, some mechanical movements, if not carefully monitored, can yield undesirable or unexpected outcomes during treatment. This case report highlights a patient that experienced such an undesirable event during orthodontic care. Patient Information: A 34-year-old Caucasian male, ASA Class I, presented to the IU Orthodontic Department with a chief concern: "I want straight teeth." He had a full step Angle's Class II molar and canine relationship with severe crowding in both arches. Cephalometric values for incisor proclination and ANB values were within normal limits. Treatment included comprehensive orthodontics, with the extraction of maxillary canines to alleviate the maxillary arch crowding. Open stainless steel coil springs were used in the mandibular arch to increase the arch perimeter and resolve the observed crowding. Clinical observations: The removal of the maxillary canines resulted in the prompt resolution of the maxillary crowding. Stainless steel open coil springs have the capacity to apply high force levels to the adjacent teeth with undesirable side effects. This patient had the springs in place for 9 weeks and it resulted in an excessive amount of mandibular incisor proclination, an anterior crossbite, and traumatic occlusion. To resolve this unexpected clinical event, the coil springs were removed and elastomeric powerchain was used to obtain proper mandibular incisor inclination and anterior incisor relationship. The case has recovered from this setback and the patient is now in the final phase of his treatment, after 11 months of total treatment. Conclusion: It is imperative that patients engaged in active orthodontic treatment be closely monitored to minimize and/or prevent unintentional tooth movements associated with contemporary orthodontic strategies.

CC16 External Cervical Resorption during Contemporary Orthodontic Treatment: A Case Report. H. MOTEVASEL*, K.T. STEWART (Indiana University School of Dentistry)

Background: The exact etiology and pathogenesis of external cervical resorption (ECR) remains unknown. Possible etiologic factors include dental trauma, intracoronal bleaching, parafunctional habits, extraction of neighboring teeth, and periodontal surgery. Additionally, orthodontic treatment is another potential predisposing factor for ECR. From 1999 to 2017, the occurrence of ECR associated with orthodontic treatment increased from 28.4% to 45.7%. External cervical resorption is a dynamic process involving the loss of dental hard tissue due to odontoclastic action. In advanced cases, pulpal tissue may also be involved. Clinically, ECR is frequently observed as a painless, pink spot on the cervical region of the tooth. Treatment options for ECR depend on the location and severity of resorption, as well as the extent of pulpal involvement. The literature cites several treatment approaches including intentional replantation, forced orthodontic eruption, root canal treatment, and dental extraction. Patient background: A 17-year-old, Caucasian male, ASA Class I, presented to the IUSD orthodontic clinic with a chief concern "I don't like my canine sticking out". Patient diagnosis included an Angle's Class II Division I Subdivision right malocclusion with moderate maxillary and mild mandibular crowding. He possessed an orthognathic skeletal relationship, normal incisor inclinations, and healthy periodontium. His planned treatment included fixed orthodontic appliances and utilization of a distal jet to distalize his maxillary right posterior teeth, in order to alleviate the maxillary crowding. After 23 months of treatment, a progress panoramic radiograph revealed

a radiolucency on the mesial root surface of #22. Additional, clinical and radiographic assessment confirmed ECR. Discussions regarding the management of the ECR in this patient are ongoing. Conclusion: Clinicians conducting orthodontic treatment should be aware of the clinical and radiographic signs of associated with ECR. When identified, prompt diagnostic and treatment decisions should be made to provide the best possible prognosis for the patient.

CC17 Orthodontic Management of Delayed Tooth Eruption: A Case Report. E. SACHS*, K.T STEWART (Indiana University School of Dentistry)

Background: Tooth eruption occurs as a tooth moves from its nonfunctional position in the bone to its functional occlusal position in the oral cavity. Normal eruption of permanent teeth into the oral cavity occurs over a broad chronologic age range, with a wide range of influential factors. There are many causative factors for delayed dental eruption, including but not limited to local conditions such as a physical obstruction, systemic conditions like hypothyroidism, and genetic disorders. Delayed dental eruption can negatively affect orthodontic diagnosis and treatment planning, thus causing a delay in treatment time and possibly undermining the outcome achieved. This case report highlights the interdisciplinary management of a patient with multiple teeth with delayed eruption. Patient background: A 17-year-old Caucasian male presented to IUSD Orthodontic Department with the chief concern: “I want my front teeth back more.” Medical history included microcephaly and adenoidectomy in 2002. Dental history included Phase I orthodontic treatment and he presented with maxillary and mandibular space maintainers. The planned treatment included removal of the space maintainers and delivery of maxillary and mandibular stabilizing arches. The maxillary stabilizing arch was made of .045” stainless steel wire attached from molar-to-molar around the buccal surfaces of the teeth. The mandibular stabilizing arch was made of .036” stainless steel wire on the lingual and .045” stainless steel wire on the buccal, attached at the molars. The patient was referred to the periodontist for the closed exposure of unerupted teeth and placement of recovery attachments. Additionally, the supernumerary 8’ and mandibular left canine were to be extracted. Power thread was used to apply the needed orthodontic force to bring the teeth into the arch. After recovery, all teeth were bonded with .022 MBT bracket prescription. Conclusion: A collaborative interdisciplinary approach can facilitate the effective management of patients with delayed dental eruption.

CC18 Surgery First Approach to Manage Skeletal Class III Malocclusion: Case Report.

J.P. THOMPSON*, K.T. STEWART (Indiana University School of Dentistry)

Background: Class III malocclusions are present in 1-7% of the global population. Treatment for such malocclusions vary depending on dental, skeletal, and soft tissue components. In severe cases, orthognathic surgery is indicated to fully correct the malocclusion. Traditionally, orthodontic treatment is required before surgery to help achieve optimal function and esthetics. Orthodontic treatment typically lasts approximately 12 months before surgery and 6 months of post-surgical orthodontics. In this case report orthognathic surgery was performed before orthodontic tooth movement. A 40-year-old Caucasian female presented with the chief concern, “My face is in constant pain due to my malocclusion.” A Class III malocclusion with maxillary skeletal deficiency, interarch attrition, and severe bilateral TMD symptoms was noted. Treatment Provided: To fully address the patient’s chief concern, a 3-piece LeFort 1 maxillary advancement with orthodontic treatment was planned. Due to finances and the patient’s malocclusion, a surgical-first approach was indicated. All erupted teeth were bonded with traditional fixed orthodontic brackets and wires. A transpalatal arch (TPA) between maxillary first molars were cemented, with extension arms extending to the maxillary second molars were cemented to move the second molars more palatally to assist with surgery. Pre-surgical orthodontics took five weeks followed by a 3-piece Le Fort-1 with maxillary advancement of transverse expansion. Post-surgical orthodontics took an additional 10 months, with a total treatment time of 11 months and 1 week. Conclusion: A surgical first approach to correct a skeletal class III malocclusion provided the patient with expedient correction of the skeletal discrepancy, addressed the chief concern, and provided the patient with an improved quality of life.

PERIODONTICS

CC19 PAOO with Simultaneous GBR for Congenitally Missing Lateral Incisors. S. AZAR*, Y. TANAKA, S. BLANCHARD, C.C. YANG, Y. HAMADA (Indiana University School of Dentistry)

This case report introduces the novel approach of a combination of Periodontally Accelerated Osteogenic Orthodontics (PAOO) and simultaneous GBR to reduce the treatment duration prior to implant placement. A 19-year-old Caucasian female presented with congenitally missing maxillary lateral incisors. The patient was in active orthodontic therapy and was interested in prosthetic replacement of missing #7 & 10 with dental implants. It was determined that there was inadequate bucco-palatal ridge dimensions at both sites for implant placement. It was also evident that at both sites the roots of the central incisors and canines were convergent and therefore there was inadequate space for narrow diameter implants. Sulcular incisions with vertical releasing incision from #5 D to #12 D were made and full thickness mucoperiosteal flap were elevated. Corticotomy cuts were made with a piezo surgery tip reaching into the cancellous layer at interdental sites from #6D to 11D. A double layer of bone grafts consisting of freeze-dried bone allograft (FDBA) and deproteinized bovine bone mineral (DBBM) were utilized. Graft materials were covered with a non-cross-linked collagen membrane. Following periosteal releasing incisions, primary wound closure was achieved. Wound healing was uneventful. A CBCT was taken nine months after PAOO and simultaneous GBR. The outcome of the orthodontic tooth movement appeared to be optimal and the horizontal ridge augmentation appeared to be of sufficient dimension. Both orthodontic tooth movement and ridge augmentation were achieved within nine months. Implants were placed with guided a surgical protocol at site #'s 7 and 10 after eleven months. Two months later a second stage procedure was performed with placement of definitive abutments and crowns at site #'s 7&10. Periodontally accelerated osteogenic orthodontics with simultaneous guided bone regeneration can be an optimal treatment option for the orthodontic patient with inadequate ridge dimension to reduce the total treatment duration.

CC20 Application of Growth Factors for Treatment of Severe Intrabony Defects. C. BATRA*, S.B. BLANCHARD, Y. HAMADA (Indiana University School of Dentistry)

Growth factors play a crucial role in wound healing and have been used to accelerate healing and therefore enhance soft and hard tissue regeneration. Gem 21S® contains platelet derived growth factor (rhPDGF-bb) which promotes periodontal regeneration. This case report demonstrates treatment of deep and wide vertical periodontal defect by application of rhPDGF-bb with 3-month follow up. A 39-year old Hispanic male was referred to IUSD Graduate Periodontology for treatment of the deep periodontal pockets. Patient was classified as ASA I. Upon intra-oral and radiographic examination, diagnosis of generalized Stage III Grade C periodontitis was made. Phase I therapy was performed with scaling and root planing and oral hygiene instructions were given. At the time of re-evaluation, #31 presented with 8-9mm probing depth on the distal aspect with a deep wide vertical defect evident on the periapical radiograph extending to the apex of the distal root. Vitality of the tooth was confirmed with EPT. Intrasulcular incisions were made extending from distal of #28 till #32 and full thickness flaps were reflected labially and lingually. The defect on #31 was thoroughly debrided of granulation tissue and additional root planing was performed. The defect was a deep, wide three-wall defect extending from buccal to lingual aspect of distal root of #31 which was 7mm deep and 5mm wide. The combination of rhPDGF-bb and porcine derived bone substitute were placed in the defect and covered with an amnion-chorion allograft membrane as a barrier. Primary closure was obtained using d-PTFE sutures. Post-operative wound healing was uneventful and the patient reported no pain or discomfort at the 3-month post-operative visit. No mobility was noted at #31 and the tooth was still positive to vitality tests. Periapical radiographic shows evidence of radiographic bone fill. The application of growth factors for periodontal defect treatment leads to favorable clinical and radiographic outcomes.

CC21 Treatment of Multiple Gingival Recession Using PRF and Alloderm™. C. CORNELIUS*, V. JOHN (Indiana University School of Dentistry)

The successful treatment of multiple sites of gingival recession in the esthetic zone requires careful planning and meticulous execution. The complexity of managing multiple sites of recession makes outcomes less predictable. However, recently there have been case reports on treating sites of gingival recession with platelet rich fibrin (PRF) as a standalone option or along with other treatment modalities. Platelet rich fibrin (PRF) is a second-generation autologous platelet rich concentrate that is known to release growth factors and cytokines that aid in

wound healing in regenerative dental procedures. This case presentation exhibits the usage of acellular dermal matrix (ADM, Alloderm, BioHorizons), a well-documented allogenic material that is used in soft tissue regeneration, along with PRF to denote its enhanced healing and regenerated outcomes over a relatively short time-point. A 31-year-old female presented with multiple sites of gingival recession in the maxillary anterior region. These recession defects identified as Recession Type 1, were treated via a tunneling approach using ADM and PRF. Patient was followed weekly for the first three weeks and the final clinical outcomes were evaluated at the third month post-operative visit. Soft tissue presented with positive healing and reduction of inflammation at the first post-op visit. Predictable complete root coverage was noted at the third month post-operative visit. This case report suggests that tunneling using ADM and PRF can yield predictable outcomes in the treatment of multiple sites of type 1 gingival recession defects.

CC22 Biologic Modifiers for Periodontal Regenerative Procedures: A Case Report.
N. DANESHPARVAR*, S. BLANCHARD, Y. HAMADA (Indiana University School of Dentistry)
Background: Utilization of biologic modifiers such as rhPDGF-bb and Enamel Matrix Derivatives (EMD) play an important role in periodontal regenerative therapies by stimulating the wound healing. Case description: A 19-year old African American female presented to Department of Periodontology with deep probing depths and severe vertical bone loss on #s 3, 7, 12 and 14. Mobility class III was found associated with #7. Periodontal diagnosis was determined as Stage III, Grade C periodontitis, Molar Incisor Pattern. Phase I of periodontal treatment was completed with localized scaling and root planing with systemic antibiotics. Following the reevaluation, deep probing depths associated with #s 3, 7, 12 and 14 persisted. Surgical phase of treatment was performed, including regenerative therapy for #s 3, 12, and 14, and extraction and ridge preservation of #7 due to the hopeless prognosis. Following local anesthesia, full thickness flap was reflected on #3, 12, and 14. Deep 1 to 2-wall defects (approximately 5-6mm depth and 4-5 mm width) were noted around these teeth. After the extraction of #7 with minimal traumatic manner, the buccal bone was found to be completely resorbed. All areas were reconstructed with combination of rhPDGF-bb, EMD, bone graft substitutes and resorbable membranes. Primary closures were obtained around #s 3, 12 and 14, but the resorbable membrane was left exposed on #7 crestal area. Post-operative wound healing was uneventful in all areas, and the patient has been followed for six months. Significant amounts of probing depth reduction and radiographic bone fill were achieved on #s 3, 12 and 14. The cone beam computed tomography (CBCT) revealed that buccal bone was completely reconstructed on #7 for future implant therapy. Conclusion: Regenerative procedures with combination of biologic modifiers, bone substitutes and resorbable membrane will contribute to soft and hard tissue reconstruction around teeth and extraction sites.

CC23 Hard Tissue Reconstruction for Implant Placement after Failed Extraction. T.FUJII*, Y. HAMADA (Indiana University School of Dentistry)
Implant therapy can predictably recover lost occlusal function after tooth extraction. However, extraction lead to crestal bone resorption. To recover lost bone volume for implant placement, guided bone regeneration (GBR) is widely applied. We present a case using GBR technique to repair lost hard tissue due to failed tooth extraction. A 72 years male patient presented at Indiana University Graduate Periodontics Clinic for removing #5 root tip. #5 had been extracted by referring dentist due to vertical fracture. A radiograph showed #5 root tip and progression of #4 attachment loss compared to a previous radiograph. The treatment plan was to replace #5 with a dental implant following bone recovery by GBR technique. Regarding GBR, full thickness flap was elevated after local anesthesia administration. #5 root tip was removed from the granulation tissue. Periosteal releasing incision was made on buccal flap to obtain tension-free primary closure. After debridement of #4 mesial root, a porcine-derived Enamel Matrix Derivative (EMD) was applied. To augment hard tissue, #5 area was filled with deproteinized bovine bone mineral (DBBM). A resorbable collagen barrier membrane was trimmed and applied over the bone graft substitutes. The flap was repositioned with combination of horizontal mattress and interrupted sutures. Wound healing was uneventful after the procedure. The radiographic bone fill was confirmed in #5 area by periapical radiograph. Implant placement for #5 area was carried out at 1 year after GBR. After full thickness flap elevation, bone reconstruction was confirmed. Following osteotomy, 4.10x10mm bone level tapered was placed. At 14 weeks postoperative visit, #5 implant was clinically stable. Radiographic evidence of bone loss was not detected. The patient was referred back for #5 implant restoration. Conclusion: GBR technique can achieve successful implant rehabilitation of traumatized crestal bone.

CC24 Treatment of Gingival Recession Using a Newer Approach. K. GANDHI*, V. JOHN (Indiana University School of Dentistry)

The literature has recognized the coronally advanced flap (CAF) with the addition of a connective tissue graft as the gold standard procedure for obtaining root coverage in Recession Type 1 defects. The sub-epithelial connective tissue graft (SECT) using a single or trap-door incision is conventionally used for harvesting the graft. This technique allows primary closure of the palatal flap but is difficult to perform and in cases of limited palatal mucosal thickness, it can result in sloughing of the thin overlying palatal flap leading to prolonged pain and discomfort. This case report describes a technique of root coverage that uses a free gingival graft (DE-FGG) which is de-epithelialized extra orally. The technique of harvesting an FGG and de-epithelializing it, is easier to perform, permits palatal harvesting regardless of palatal mucosal thickness and contains less fatty and glandular tissue than SECT. Case Presentation: A healthy 36-year-old African-American male patient presented to the Graduate Periodontics Clinic with an isolated buccal recession on #6 (RT1). The recession depth and width were measured as 4 mm. Root coverage was performed using a CAF in combination with a DE-FGG. The free gingival graft was obtained from the left side of the palate and the epithelium of the FGG was removed from the graft using a 15-c blade. The DE-FGG was stabilized on the recipient bed and completely covered with a CAF. A 4-week follow-up was done. Healing was uneventful with slight inflammation at 1and 2 weeks. The inflammation reduced with time with complete root coverage at 4 weeks. The patient will be followed up for evaluation of contour and consistency. Conclusion: Recession defects can be treated with a de-epithelized FGG and this technique may serve as an alternative for the conventional SECTG or de-epithelialized grafts.

CC25 Application of CO_2 Laser in Lingual Frenectomy for Adult Ankyloglossia. B. HERRON*, Y. HAMADA (Indiana University School of Dentistry)

Ankyloglossia is a congenital condition restricting movement of the tongue due to short lingual frenal attachment that might limit tongue movements. Lasers in dentistry have many purposes commonly dealing with coagulation or incision of hard and soft tissues. Carbon Dioxide (CO_2) lasers are mainly used for soft tissue procedures and ablation occurson soft tissue surfaces with minimal penetration. Hemostasis and blood coagulation from laser ablation may aid in reducing post-operative pain and swelling. The purpose of this case report is to demonstrate the healing potential surrounding an adult lingual frenectomy treated with a CO2 laser. A 21-year-old Caucasian male desired elective lingual frenectomy treatment due to social insecurity and to improve self-confidence when speaking and functioning. Clinical examination revealed lingual frenal attachment near anterior border of tongue immobilizing protrusive, lateral, and elevational movement causing functional and phonetic limitation. Following the local anesthesia, a 10,600nm wavelength CO_2 (incision mode: 2.0W focused, continuous wave) was used to make a horizontal incision at the base of the tongue. The incision was extended medially until the tip of tongue was able to protrude without any difficulties. The surgical area was very clear due to prompt hemostasis with laser effects. The total of 3 single interrupted sutures were placed to stabilize the wound. The sutures were removed at the 1-week post-op where a fibrin layer covered the entire surface of the incision area. Minimal redness surrounding the incision was present and mild discomfort upon movement was reported from the patient. Full epithelial coverage with no remaining patient-reported discomfort was seen at 1-month post-op. Conclusion: this case report suggests that CO_2 lasers are safe to use for soft tissue surgery, and the blood clot cicatrization could improve patient post-operative comfort level by stabilizing the wound and protecting the raw surface.

CC26 Localized Juvenile Spongiotic Gingival Hyperplasia (LJSGH). U. JANU*, S. ZUNT, S.B. BLANCHARD (Indiana University School of Dentistry)

LJSGH is a poorly understood but distinctive inflammatory hyperplasia occurring in children and young adults. Fewer than 100 cases have been reported since its initial description. In 2007, this condition was first described as “juvenile spongiotic gingivitis” to highlight its spongiotic and inflammatory nature and was later renamed as “localized juvenile spongiotic gingival hyperplasia” to emphasize its localized clinical nature and hyperplastic morphology seen on microscopy. This case report presents a case of LJSGH. A 12 year-old boy, presented with a well-circumscribed solitary bright red papillary edematous lesion on the gingiva of # 8 extending to mucogingival junction which bleeds on brushing. Incisional biopsy was done under local anesthesia, and the specimen was submitted for histological examination with LJSGH, plaque-related gingivitis, hemangioma as differential diagnosis. Histopathological findings were papillary proliferation areas of nonkeratinized, variably acanthotic

stratified squamous epithelium that exhibited spongiosis, elongation of rete pegs, long connective tissue papillae, and a neutrophilic infiltrate which supported the final diagnosis of LJSGH. Topical steroid therapy was prescribed but there was no significant improvement due to patient's erratic-compliance. Next, localized ablation using CO_2 laser was done along with continued topical steroid therapy. Lesion recurred 3-4 months after laser ablation at the same site as well as extended to other sites as well. Patient is being followed up every 2 months for 2 years. CONCLUSION: LJSGH is a recently introduced entity with unclear etiology. LJSGH is typically resistant to oral hygiene measures. The course can be waxing and waning or progressively enlarging with recurrence rate of 6-16.7%. The clinical and histopathologic characteristics of LJSGH are unique and consistent. For asymptomatic lesions, observation would be a viable treatment option for this benign entity.

PROSTHODONTICS

CC27 Three-Dimensional Printing (3DP) of Interim Implant Supported Fixed Complete Denture (IFCD). L. ALMEJRAD*, W.S. LIN, O. CAYETANO, J.A. LEVON, D. MORTON (Indiana University School of Dentistry)

Introduction: Three-dimensional printing (3DP), or additive manufacturing, is one of the rapidly developing technologies in dentistry. It provides a way for individualized dental treatment for each patient. It has advantages over the subtractive manufacturing technology such as computer numerical control milling in terms of flexibility, efficiency, and minimal material waste. Case Report: A 57years old white female patient presented with maxillary interim implant supported fixed complete denture (IFCD) and mandibular fractured (IFCD). She was wearing them for 10 years. Prior to the definitive prosthesis, new interims IFCD were planned. Conventional impressions with splinted impression copings and polyvinyl siloxane (PVS) were made, and the diagnostic casts were articulated. A diagnostic tooth arrangement was tested and confirmed intraorally and scanned with a laboratory scanner. Interims IFCD were printed with a Digital Light Synthesis 3D printer. Discussion: Interims IFCD were planned to re-establish the occlusal vertical dimension and restore the desired esthetic and functional outcomes for the patient, prior to the definitive prosthesis fabrication. The 3DP is a cost-effective way to manufacture the interim IFCD from the scanned diagnostic tooth arrangement. However, gingiva-colored composite resin is required to customize the interim prosthesis for the desired esthetic outcome. Conclusion: The 3DP shows a promising potential to produce accurate, cost effective treatment alternative to conventional heat-polymerizing interim IFCD.

CC28 Implant-Supported CAD/CAM Milled Zirconia Prosthesis Supported By Titanium Bar. S.A. ALQAHTANI*, A. ALFIFI, J.A. LEVON, D. MORTON, W.S. LIN (Indiana University School of Dentistry)

Background: Patient presented to graduate prosthodontics clinic with two zygomatic implants and three reduced diameter implants in the maxilla and four reduced diameter implant in the mandible. Patient came with fractured interim maxillary and mandibular acrylic hybrid prostheses. Clinical Treatment: Patient existing maxillary and mandibular prostheses were repaired with acrylic resin to restore esthetics and function. Implant level impressions of maxillary and mandibular implant were made to fabricate verification devices using pattern resin. Verification devices were sectioned and joined intraorally to reduce polymerization shrinkage. Then new implant level impressions were made with the verification devices and to capture the peri-implant soft tissue. Occlusal records were made to evaluate the lip support and to capture the maxilla-mandibular relationship. Arbitrary face bow record was used to articulate the maxillary cast to semi-adjustable articulator. Analog diagnostic tooth arrangement was made and confirmed by the patient. Then the diagnostic tooth arrangement was scanned and titanium bars were milled according to the available space. PMMA trial prostheses were milled according to the diagnostic tooth arrangement. The milled bars and milled PMMA teeth were tried in to confirm centric record as well as esthetic and phonetic outcome. Tooth shade was selected according to patient desire. Milled zirconia prostheses were luted to the titanium bars using resin cement. Zirconia hybrids were tried, and patient esthetic and function matched patient expectations.

CC29 Esthetic Rehabilitation of a Patient with Severe Dental Fluorosis. A. ALSHEHRI*, O. CAPIN, N.B. COOK, K. DIEFENDERFER (Indiana University School of Dentistry)

Fluoride is essential for prevention of dental caries; however, ingestion of high concentrations during tooth development can cause dental fluorosis. The recommended optimal fluoride concentration in drinking water has

been lowered from a range of 0.7-1.2 ppm (mg/L) to 0.7 ppm to minimize the risk of fluorosis while maintaining the caries preventive benefits. Fluoride in drinking water should not exceed 2 ppm as this level can lead to severe forms of dental fluorosis. This case report is for a patient presenting with severe fluorosis. The patient is from a village in Limpopo province in South Africa. A large portion of the population in this province lives in rural areas and depends on groundwater containing high concentrations of fluoride for drinking. She reports that most of the people in her village had teeth that looked like hers. She had macro- abrasion done to the maxillary six anterior teeth earlier in her life to improve appearance. When she presented to IUSD Graduate Operative Clinic, a diagnostic wax-up was completed, teeth #4- 14 & #22-27 were prepared for porcelain veneers (e.max layered with feldspathic porcelain), #3 for a crown (e.max layered with feldspathic porcelain) and #19-21 & #28-30 for FPDs (zirconia layered with feldspathic porcelain). Bis-acrylic provisional restorations were fabricated using a silicone index from the diagnostic wax-up to serve the patient until the final restorations were ready for delivery. Fluoride in drinking water should not exceed 2 ppm in an effort to prevent severe dental fluorosis and the associated negative esthetic consequences.

CC30 Dual-Purpose 3D Surgical Template for the Fractured Dental Implant Removal. T. GADAH*, V. DUTRA , W. POLIDO, A. AL-SHAHRANI, A. MAJEED-SAIDAN, W.S. LIN, D. MORTON (Indiana University School of Dentistry)

Objectives: Multiple factors could affect the survival of dental Implant. These factors include Poor implant planning, implant factors, location and position factors, biomechanics factors, and clinician's factors. Cone-Beam Computed Tomography aided 3D printed surgical template was designed to identify the location of a fractured dental Implant in the buccal aspect of left maxilla. In addition, immediate implant placement was performed using the same 3D printed surgical template. Methods: CBCT aided 3D Printed surgical template was designed to locate the fractured Implant. A full-thickness mucoperiosteal flap was raised to expose the buccal cortex of area of the right first premolar. The tooth-supported surgical template was seated. PIEZOSURGERY white was used to remove the bone and expose the fractured Implant. After the successful removal of the fractured dental implant, a 3.3 10 mm bone level tapered implant was immediately placed with using the exact surgical template. Conclusions: A Computed designed 3D printed surgical template helped in locating the fractured dental implant, which in return minimized the additional bone removal, injury to an adjacent structure, and placing a new implant all at the same time.

CC31 Application of 3D Facial Scan in Digital Smile Design. W. KIETTIPIRODOM*, J.A. LEVON, D. MORTON, W.S. LIN (Indiana University School of Dentistry)

3D facial scan has been gaining popularity in Dentistry. Incorporating 3D facial scan in digital smile design allows for more realistic simulation and visualization of treatment outcomes. The purpose of this clinical report is to show the digital workflow utilizing 3D facial scan, intraoral scan, and CAD/CAM software to facilitate digital smile design to treat the patient with high demand esthetic outcome. A 62-year-old female patient presented with very bulky and buccally maxillary and mandibular anterior crowns #6-11 and #22-27 with too opaque color. The treatment plan was to replace all maxillary and mandibular anterior crowns. Digital data was acquired by an intraoral scanner (Straumann) and a 3D facial scanner (Bellus 3D). The intraoral scan and facial scan were merged together to create a 3D virtual patient. Then, teeth alignment, teeth preparation, and teeth wax-up were performed virtually. The 3D digital smile design was presented to the patient for approval. After removing all previous crowns, prepared teeth were scanned to make long-term provisional crowns to confirm the final outcome before fabricating the final restoration. Conclusion: This technique could be used when patients present with pre-existing restorations that prevent clinicians from a traditional analog mockup. Utilizing intraoral scan and 3D facial scan combining with digital smile design seems to be an alternative way to present possible treatment outcomes to patients, as well as, can be used as an effective guide for treatment in esthetic zones.

CC32 Implant Surgical Planning in a Patient with Severely Atrophic Mandible. Y.C. LAI*, J.A. LEVON, D. MORTON, W.S. LIN (Indiana University School of Dentistry)

Objective: Implant-retained mandibular overdenture is well recognized as a desirable treatment for edentulous patients. However, severely atrophic anterior mandible with extended lingual concavity is not uncommon and may cause severe surgical complications such as perforation of the lingual plate during osteotomy. Therefore, a

delicate prosthetically-driven surgical plan is necessary before the surgery. Background: A 69-year-old female patient presented with existing dentures. Her chief complaint was the poor retention of her mandibular denture. Different treatment options were presented to the patient, including maxillary complete denture and, mandibular implant-supported fixed complete denture or mandibular implant-retained overdenture. Mandibular implant-retained overdenture with 2 dental implants was accepted by the patient. Treatment sequence and methods: A mandibular record base was made for registration of centric relation at desired occlusal vertical dimension. A new mandibular diagnostic tooth arrangement was completed. After clinical trial insertion, the dual scan protocol was adopted in the following procedures: 6 fiducial markers were attached onto the diagnostic tooth arrangement. Two DICOM datasets were acquired by CBCT imaging, one is extraoral imaging on diagnostic tooth arrangement only and the other is intraoral imaging with diagnostic tooth arrangement in situ. The two sets of DICOM files were imported, processed and registered into an implant planning so\ware program (CodiagnostiX). Segmentation and surgical plan were completed according to the desirable definitive prosthesis contour and volume. Conclusion: Prosthetically-driven surgical plan can be realized by computer-guided implant surgery. The dual scan imaging protocol has a pivot role in evolution from analog to digital surgical planning. With the use of 3D-printed surgical template, dental implants can be placed in the area with compromised anatomic structure safely.

CC33 Full-Arch Maxillary Rehabilitation Using Dual Scan CBCT. Y. TANAKA*, J.A. LEVON, W.S. LIN
(Indiana University School of Dentistry)

The placement of a complex dental prosthesis that is supported by dental implants can be quite challenging for the implant team. Many clinical issues must be evaluated beforehand and there should be good communication among the members of the team and the patient. Understanding lip mobility, lip support, and tooth position can often be helpful during the diagnosis stage. However, it is sometimes difficult to make decisions with malpositioned teeth, especially a patient with terminal dentition. We present a case using immediate denture as a communication tool with a patient and also as implant position planning tool for dual-scan CBCT. A 66-year-old Caucasian male presented to the Graduate Prosthodontic Clinic for full mouth rehabilitation with dental implants. The patient presented with missing teeth #1-5, 10, 11, 13-16. An initial surgery was done to remove the all maxilla teeth and place an immediate denture. Five months after the extraction, we evaluated lip support and the patient needed the support for his esthetic profile. If patients need a lip support, we recommend to place implant overdenture instead of implant supported fixed prosthesis. After the discussion, we decided to plan for fixed dental prosthesis and we would evaluate patient's hygiene technique. If the patient is not able to clean the prosthesis, we will then place an implant overdenture. Two scans were performed with a CBCT scanner. One scan was of the denture alone and a second was of the patient wearing the denture in a fully seated position. Implant positions were digitally planned and a 3-D surgical guide was fabricated. Implants were placed through the guide for maximum accuracy and we delivered an immediate loading prosthesis. In conclusion, placing immediate complete denture before implant placement may lead to more predictable functional and esthetic outcomes.

Index to Primary Presenters and Mentors

Mentors are italicized

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