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

William Jarvie, 1905
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Acknowledgements
A Message from the Editor

As the current Editor-in-Chief, I am proud to present the 56th edition of the Journal of the William Jarvie Society. The Jarvie Society carries through on one of the inherent philosophical principles of our school, to promote the advancement of patient care through the involvement of student research. The exceptional content of this year’s journal demonstrates why the College of Dental Medicine is one of the top research institutions in the dental field. Both pre and post-doctoral students have contributed a significant number of abstracts. From basic science to public health, Columbia students are actively engaged and excelling in various research projects. The high quality of research at Columbia is also a reflection of the unwavering dedication of the faculty mentors.

I would first like to thank the Journal’s advisor, Dr. Carol Kunzel, and Ms. Kelli Johnson for their assistance and guidance during the preparation of this Journal. Without them, the printing of the Jarvie Journal and the Birnberg Research Day would not exist. In addition, I would like to thank Dean Ronnie Myers, Dean Letty Moss-Salentijn, and Dean Jeremy J. Mao for their continual support of student research at Columbia.

Without the help of my associate editors; Jose Castillo, Thomas Choi, and Agelina Paek, I would have been completely overwhelmed. I greatly appreciate your time, effort, and energy. Thank you to the rest of the William Jarvie Society board for your hard work throughout the year. Finally, thanks to all members of the William Jarvie Society. I’m very fortunate to have been surrounded by students with such intellectual curiosity.

Congratulations to all those with published abstracts in this Journal. I hope the success of both pre and post-doctoral students demonstrated in the following pages inspires other students at CDM to pursue research projects of their own.

Matthew J Cozin
Editor-in-Chief
Class of 2013
March 29, 2013

Members of the Jarvie Society,

It gives me great pleasure to write and congratulate you on the 56th edition of the Jarvie, the Journal of the William Jarvie Society. What better way to recognize the true roots of dental research than through this Journal, the abstracts within it, and the recognition of all of our student research scholars.

How appropriate that William Gies, the founder of the American Association of Dental Research (AADR) and a true Columbian, would establish such a student dental research society in 1920 only four years after the establishment of the dental school at Columbia University. Today, 93 years later, this organization continues to be a vital part of the College of Dental Medicine (CDM) with over 25% of the student body participating.

A culture of inquiry is embedded in the CDM. It is how we teach and mentor our students, residents and postdoctoral candidates. The fabulous abstracts that are recognized in this manuscript, the posters that are being displayed during our Birnberg presentation and the overall quality of the mentor/mentee relationships continues to show our innate desire to answer the questions that so need to be answered for the betterment of oral and systemic health.

You should be proud of what you have accomplished and I congratulate each and every one of you on the extraordinary display of your scholarship.

Sincerely,

Ronnie Myers DDS
Interim Dean
March 30, 2013

Dear Members of the Jarvie Society,

The Jarvie Society continues its great tradition of student research at the Columbia University College of Dental Medicine. This is something to be proud of as it indicates the recognition by the newest members of our profession that research is essential for the survival and growth of dentistry as an academic discipline. This publication is evidence of the commitment of all the students who have been involved in research projects during the past year and have prepared abstracts of their findings.

We all recognize and applaud the extra effort that was made by the students and residents to work on these research projects after a long day of being in class, in the preclinical laboratory, or in the clinics. Similarly, we value the time and effort of the mentors who guided the research, supervised the analysis of the data and the preparation of the reports. It is this collaboration that may become a life altering experience for a lucky few and lead to a lifetime of research.

I sincerely hope that some of you may have that experience. I look forward to learning more about your research on Student Research Day!

Letty Moss-Salentijn, DDS, PhD
Robinson Professor of Dentistry
(in Anatomy and Cell Biology)
Vice Dean for Academic Affairs

Columbia University Medical Center
March 26, 2013

Members of the Jarvie Society:

I write to convey my sincere congratulations to each of you on what you have accomplished in your research project. Members of the Jarvie Society have collectively demonstrated that one can be a part of scientific inquiry, while pursuing professional education in dental medicine. At this important juncture, I also express my gratitude towards your mentors who have sponsored your research projects and provided you with fine tools for scientific discovery.

Columbia University has a rich and long-standing history in dental and craniofacial research. William John Gies (1872-1956), a professor of Biochemistry at Columbia, is recognized as a pioneer by dental education and research communities worldwide. Almost a century ago, Professor Gies and his colleagues founded or co-founded the Journal of Dental Research, the American Association for Dental Research (AADR) and the American Association of Dental Schools. Professor Gies authored the first comprehensive report on dental education in 1926, a 650-page document written on a typewriter and widely acknowledged as the Gies Report as of today. In 1916, Professor Gies and a group of New York dentists founded the school in which now you all study.

As many of you now understand, research is about spending many hours, frequently tedious, in front of laboratory benches, computer screen, or identifying specifics in patient charts. However, I would submit that research is more than those tedious hours – it is also about searching for clues that perhaps few others know. What a plus it is that some of the clues you are searching may well form pieces of a puzzle, that once solved, may prevent, treat or even cure diseases of fellow human beings. For those who are thrilled not only by its promise, but also endure its frustration and enjoy its outcome, research is one of the creative processes in life well worth exploring.

Research is an integral part of graduate and professional learning, for without research, a profession is deprived of its vitality. Again, my hat goes off to each of you on this important occasion that marks your contribution to the profession, and for some of you, perhaps the beginning of a lifelong journey for knowledge discovery.

Sincerely,

Jeremy J. Mao, DDS, PhD Edwin S. Robinson Professor Co-Director, Center for Craniofacial Regeneration Senior Associate Dean for Research, College of Dental Medicine
History of the William Jarvie Society*

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

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

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

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

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

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

The Birnberg Research Award was established by the Alumni Association of the Columbia University, School of Dental and Oral Surgery in the early 1950s to encourage dental research of excellence and to help stimulate public interest in support of dental research. The award is named in honor of Dr. Frederick Birnberg (1893-1968), class of 1915, who helped to establish a research fund.

The College of Dental Medicine faculty research advisory committee, in conjunction with the school’s Alumni Association, considers individuals who have made important contributions to dentistry through both research and mentoring for selection as Birnberg Lecturer and recipient of the Birnberg Award. Fifty-six outstanding scientists and teachers have been honored as the Birnberg Lecturer since the first Birnberg Award was presented in 1954.

Birnberg Lecturers and Award Recipients

1954 Dr. Charles F. Bodecker   1977 Dr. George Green   1996 Dr. Lorne M. Golub
1955 Dr. Joseph Appleton      1978 Dr. David Scott    1997 Dr. Bruce J. Baum
1956 Dr. Isaac Schour          1979 Dr. Berge Hampar   1998 Dr. Kenneth Anusavice
1957 Dr. Ralph Phillips        1980 Dr. Barnet Levy     1999 Dr. James D. Bader
1958 Dr. Reider F. Sognnaes    1981 Dr. Ronald Dubner   2000 Dr. Lars Hammerström
1959 Dr. John Knuston          1982 Dr. Martin A. Taubman 2001 Dr. David T. W. Wong
1960 Dr. Maxwell Karshan       1983 Dr. Louis T. Grossman 2002 Dr. Henning Birkedal-Hansen
1961 Dr. George Paffenbarger   1984 Dr. Solon A. Ellison 2003 Dr. Barbara Dale-Boyan
1962 Dr. Eli Goldsmith         1985 Dr. Norton S. Taichman 2004 Dr. Paul B. Robertson
1963 Dr. Edward V. Zegarelli   1986 Dr. Ronald J. Gibbons 2005 Dr. Bruce L. Pihlstrom
1964 Dr. Francis A. Arnold     1987 Dr. Robert J. Gorlin 2006 Dr. Jeffrey D. Hillman
1965 Dr. Seymour Kreshover     1988 Dr. Enid A. Neidle      2007 Dr. Ralph V. Katz
1966 Dr. Paul Goldhaber        1989 Dr. David H. Pashley   2008 Dr. Robert J. Genco
1968 Dr. Sholom Peariman       1990 Dr. William H. Bowen   2009 Dr. Deborah Greenspan
1970 Dr. Melvin Moss           1991 Dr. Harold C. Slavkin 2010 Dr. Sally J. Marshall
1971 Dr. Irwin Mandel          1992 Dr. George R. Martin   2011 Dr. Michael Longaker
1973 Dr. Lester Chan           1993 Dr. Richard Skalak     2012 Dr. R. Bruce Donoff
1975 Dr. Russell Ross          1994 Dr. Ze’ev Davidovitch 2013 Dr. Peter J. Polverini
1976 Dr. Jerome Schweitzer     1995 Dr. Ivar Mjor
2013 Birnberg Lecturer and Award Recipient

Peter J. Polverini is Dean of the University of Michigan School of Dentistry. Dr. Polverini holds a bachelor’s degree in biology and a DDS from Marquette University. He completed specialty training in Oral and Maxillofacial Pathology at the Harvard School of Dental Medicine and was awarded the Doctor of Medical Sciences degree from Harvard University. In 1977 he was appointed as an assistant professor in the Department of Diagnostic and Surgical Sciences at the University of Pittsburgh School of Dental Medicine. In 1981 he was recruited to the Department of Pathology, Northwestern University Medical and Dental Schools.

In 1992 Dr. Polverini joined the University of Michigan as a professor of dentistry and chief of Oral and Maxillofacial Pathology. He was appointed chair of the Department of Oral Medicine, Pathology, and Surgery in 1995, and a year later became chair of the Department of Oral Medicine, Pathology, and Oncology. Dr. Polverini left the University of Michigan in 2000 to accept the Deanship at the University of Minnesota School of Dentistry. In 2003 he returned to the University of Michigan as Dean of the School of Dentistry.

Dr. Polverini has a distinguished scientific career in the field of vascular biology where he has long been a leader and influential figure. His research focuses on angiogenesis (the growth of blood vessels) and its relationship to cancer and chronic inflammatory diseases. He is the author or co-author of more than 150 scientific articles, textbooks and book chapters, and has four patents. He has made more than 80 scientific presentations to groups in the U.S. and overseas and is an editorial consultant for more than 30 scientific journals. He is widely recognized as an accomplished mentor, scholar, motivator and seasoned administrator who has fostered innovation in dental education by promoting scholarship and scientific rigor.

Dr. Polverini is a Diplomate of the American Board of Oral and Maxillofacial Pathology, a recipient of the Distinguished Scientist Award in Oral Medicine and Pathology from the International Association for Dental Research and a Fellow of the American Association for the Advancement of Sciences. Dr. Polverini was elected to the Institute of Medicine of the National Academies in 2010. Dr. Polverini will assume the Presidency of the American Association for Dental Research in March of 2013.
2013 Birnberg Research Program

Tuesday, April 9th, 2013

2:00 - 4:30pm  Student Table Clinic and Research Poster Session
Bard Hall, 50 Haven Avenue, Main Lounge

Wednesday, April 10th, 2013

12:00-1:20pm  Birnberg Lecture and Award Presentations
Room 401, Hammer Health Science Center,
701 Fort Washington Ave.

1:30-2:30pm  Faculty / Student Luncheon
Riverview Lounge, 4th Floor Hammer Health Science Center,
701 Fort Washington Ave.

2:45-4:00pm  Dedication of Dr. Irwin Mandel Conference Room
Ceremony & Reception
17th Floor Conference Room, Presbyterian Hospital (PH17W-311)
A message from the President of the William Jarvie Research Society

Throughout the academic year, the William Jarvie Research Society has played a vital role in stimulating student interest in research and scientific discovery. The Executive Board has striven to achieve the Society’s goals, including regular discussions of scholarly research, connecting students with mentors, and creating an atmosphere that encourages sincere pursuit of dental research.

As we reflect on the Society’s activities, here are a few examples of how we continue the Jarvie tradition. We began the year with our monthly journal clubs where volunteers dissected relevant scientific articles and presented them to the membership for discussion. In a symbiotic informational seminar, second-year dental students got the chance to hone their presentation skills before a crowd of first-years eager to get involved in research at Columbia. One of the highlights of the year was Dr. Wadhwa’s lunch-and-learn on how to make meaningful research contributions as a dental professional. Unsurprisingly, his approachable nature meant he could immediately engage students in his work in craniofacial research.

At the annual Birnberg Research Symposium, the capstone of the Society’s activities, we saw a high volume of predoctoral and postdoctoral participants presenting quality research. It culminated with Dr. Peter Polverini, Dean of the University of Michigan School of Dentistry, giving the lecture as the Birnberg Awardee.

The activities and accomplishments of the William Jarvie Research Society are the direct result of much effort from many people. Dr. Carol Kunzel, Director of the Office of Research Administration, and Dr. Jeremy Mao, Senior Associate Dean for Research in the College of Dental Medicine, deserve special recognition for their constant guidance in the activities of the Society. Additionally, we extend our sincerest gratitude to Kelli Johnson of the Office of Research Administration for working tirelessly to making Birnberg a success. From the administration, the Society would like to thank Dean Ronnie Myers and Dr. Letty Moss-Salentijn for their continual support of student research endeavors. Lastly, I want to thank all of the members of Jarvie for this opportunity and their enthusiasm. Our executive board has worked diligently to make this another successful year. It has been an honor and a pleasure to serve as President, and I sincerely look forward to the continued advancement of our organization in the future.

Jeffrey Hajibandeh
President
Class of 2014
2013 William Jarvie Society

Officers:

Editor-in-Chief: Matthew Cozin ‘13
President: Jeffrey Hajibandeh ‘14
Vice President: Brendan O’Rourke ‘14
Secretary: Ashley Houle ‘15
Treasurer: Pasha Shakoori ‘14
Associate Editors: Jose Castillo ‘14
Thomas Choi ‘16
Agelina Paek ‘14
Event Coordinator: Amanda Dewundara ‘15

Advisors:

Dr. Jeremy J. Mao
Senior Associate Dean for Research
Dr. Carol Kunzel
Director of the CDM Office of Research Administration

Members:

Aronson, Ross          Brett, Chris          Cabri, Bianca
Castillo, Jose         Castro, Michelle       Chang, Will
Chen, David            Chen, Jenny            Cheng, Ken
Choi, Thomas           Chou, Conrad           Coffey, Ashley
Corpron, Ben           Cozin, Matt            Cumnematch, Ashi
Davary, Ashkan         Donohue, Brianne        Ecson, Jhane
Ferraro, Andrew        Fiedor, Ewelina         Furmanek, Kevin
Gianfrancesco, Christa Gong, Amina          Gordon, Jason
Han, Jenny Jieun       Houle, Ashley           Hudelson, Brekke
Hutton, Gardette       Isseroff, Yehuda        Karwacki, David
Kim, Jean              Kim, Sean               Kotecki, Mike
Kotsikonas, Jennifer   Le Goff, Annia          Lee, Roger
Lemke, Ryan            Levrant, Valerie        Mainkar, Anshul
Maleeh, Imad           Moriarty, Elizabeth      O’Rourke, Brendan
Park, Mike             Perez, Karla             Pilloni, Jessica
Pougher, Shyenne       Prabhakaran, Nina       Price, Ryan
Quick, Jessica         Roos, Erik              Sheen, Alex
Soletic, Luke          Sugar, Andrew           Sydorak, Inna
Tran, Paul             Warder, Clayton          Wilson, Terrahney
Yakubov, Yakov
Pre-Doctoral Student Abstracts
Multiphase Bioscaffold for Integrated Regeneration of Root-Periodontium Complex

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Objectives: Regeneration of root and periodontium holds a promise to overcome current limitations of dental implant therapy, including its dependence upon supporting bone structure and lack of biological integration and remodeling with host alveolar bone. Here, we develop an integrated scaffold with multiphase microstructure and spatial-delivered bioactive cues, and its potential in generating root-periodontium complex from dental stem/progenitor cells is tested both in vitro and in vivo.

Materials and Methods: Polycaprolactone (PCL)-hydroxylapatite (HA) (90:10wt%) scaffolds were fabricated (5×5×3mm³) using 3D printing per our prior works. The scaffolds consisted of three phases: A) 100µm microchannels with 2.25mm in width, B) 600µm microchannels with 500µm in width, and C) 300µm microchannels with 2.25mm in width. Phases A, B, and C were designed to guide formation of dentin/cementum, periodontal ligament (PDL), and alveolar bone, respectively. To promote cell differentiation, PLGA microspheres encapsulated with Amelogenin, CTGF, and BMP2 were incorporated in phase A, B, and C of the scaffolds, respectively. To test various cell types and their responses, scaffolds were seeded with human dental pulp stem/progenitor cells (DPSCs), periodontal ligament stem/progenitor cells (PDLSCs), or alveolar bone stem/progenitor cells (ABSCs) with approximately 100,000 cells per scaffold. In vitro scaffolds were grown in modified DMEM media, while in vivo scaffolds were implanted subcutaneously into nude mice. Both models were harvest at four weeks and multiphase tissue formation in the scaffolds was evaluated by multitude of assays.

Results and Conclusions: Immuno-/histomorphometric analysis demonstrated that multiphase scaffold microstructure with spatial-delivered bioactive cues successfully generated multiphase putative tissues consisting of collagen I-rich fibrous matrix (Phase B) sandwiched between mineralized regions in both in vitro and in vivo (Phase A and C). DSP-positive mineralized structure in Phase C was highly dense and polarized (reminiscent of native dentin) in comparison with that of Phase C. DPSC’s were superior to the other cell types in mineralization, whereas PDLSC’s yielded highly aligned fibrous structure as compared to the other cell types. In vivo results further demonstrated highly aligned fibrous tissues inserting into CEMP+ mineralized matrix. PCR demonstrated amplified levels of tissue specific markers in the GF+ scaffolds: Phase A (putative alveolar bone) expressed relatively high levels of BSP (p<0.05), Phase B expressed relatively high levels of COL-1 (p<0.05), Phase C expressed relatively both DSPP and marked CEMP-1 levels (p<0.05).

Discussion: Our findings suggest a strategy to recapitulate the multiple tissues of the root-periodontium from dental stem/progenitor cells. Putative alveolar bone, PDL, and cementum/dentin-like structures Multiphase scaffolds with spatially delivered bioactive cues may serve as an efficient tool for root-periodontium regeneration.

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**Trib3, a Pro-Apoptotic Protein, May Contribute to Neuronal Death in Parkinson’s Disease**

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**Introduction:** Parkinson’s disease (PD) is the most common neurodegenerative movement disorder and is characterized by the progressive loss of several neuronal populations in several areas of the brain, particularly the substantia nigra. Patients with PD can experience serious challenges to daily home dental hygiene routines such as brushing, flossing and denture cleaning. The therapeutic approaches for the treatment of PD ameliorate some of the clinical symptoms, but do not halt or slow disease progression. Previous studies in mice and rats have demonstrated that the pro-apoptotic gene, Trib3, is induced in various cell death mechanisms. The work presented here examines the role of Trib3 in apoptosis (neuronal death), with samples from human patients. Understanding the mechanism of cell death, such as the role Trib3 might play, will enable us to better target the development of drugs for the treatment of PD.

**Materials and Methods:** Paraffin embedded postmortem brain samples were obtained from the New York Brain Bank at Columbia University (New York, NY). Immunocytochemistry was performed with 7 µm thick deparaffinized sections using an avidin biotin kit and peroxidase substrate from Vector Laboratories (Burlingame, CA; VECTASTAIN Elite Goat IgG ABC Kit, ImmPACT SG Peroxidase Substrate). A Trb3 polyclonal antibody prepared against a human Trb3 peptide was obtained from AbCam (Cambridge, MA; catalogue #84174; lot #940501) and used at a dilution of 1.0 µg/ml. The Trb3 antibody was absorbed with the immunizing Trb3 peptide in control experiments (AbCam; catalogue #ab93788, lot # 941648; 1µl peptide to 1ml of 1.0 µg/ml Trib3 antibody). Following immunocytochemistry, sections were counterstained (Nuclear Fast Red; Vector; catalogue #H-3403), coverslipped (Vector; catalogue #H-5000) and examined using light microscopy.

**Results & Conclusions:** Cytoplasmic Trib3 staining was observed in a small subpopulation of substantia nigra neurons in both control and PD patients. However, we found that patients with PD have a statistically significant increase in the percentage of neurons expressing Trib3. This suggests that Trib3 may be an indicator of neurons that will undergo apoptosis. We have also begun examining the expression of Trib3 in other brain areas affected by PD, such as the caudate nucleus and putamen. Preliminary results in control patients indicate a low level of Trib3 in many neurons in these areas and we will be comparing these results to those of PD patients.

**Discussion:** Trib3, a pro-apoptotic protein, has been shown to be induced in cells under stress such as hypoxia, starvation, endoplasmic reticular stress and mitochondrial stress. Our results indicate that the proportion of neurons expressing Trib3 is higher in the substantia nigra of human patients with PD. Other experiments have shown Trib3 inducing and mediating death in cellular models of PD, as well as cultured midbrain samples of rats with toxin induced PD. If Trb3 is shown to be a factor in the neuronal cell death seen in PD, a drug could be developed that blocks the production of Trib3. This would prevent any further death of neurons in PD patients and ensure that the patients’ health will not continue to decline.

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A Tooth Model Evaluation of Human Dental Pulp Cell Response to PEGDA Hydrogel
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Introduction: More than 24 million teeth receive root canal treatment each year. Current endodontic treatment replaces vital pulp tissue with synthetic material. Teeth whose pulp tissue has been removed are more vulnerable to injury, which threatens the longevity of the tooth. Therefore, a treatment which is able to maintain the vitality of the pulp or regenerate pulp tissue provides a preferable alternative to current endodontic treatment. Synthetic biomaterial scaffolds play an essential role in new tissue formation. An appropriate scaffold for pulp tissue regeneration should support pulp cell viability, proliferation, and matrix synthesis. Polyethylene glycol diacrylate (PEGDA) hydrogels have been investigated as matrices for engineering various tissues. PEG hydrogels are synthetic, biocompatible, hydrophilic polymers composed of 3D interstitial cross-links. These polymers have the advantage of being injectable, photocrosslinkable, and their mechanical properties can be precisely controlled by altering weight percent, molecular chain length, and crosslinking density. The current study uses a tooth organ model, which simulates the clinical situation of pulp tissue regeneration, for evaluating PEGDA-based scaffolds as a substrate for supporting human dental pulp cell regeneration.

Objective: To assess the response of human dental pulp cells in a PEGDA hydrogel cultured within human teeth. Cell viability, proliferation, mineralization potential, and collagen deposition were analyzed. We anticipate that a PEGDA-based gel will support pulp cell viability, proliferation, mineralization potential and collagen deposition.

Methods:
Scaffold Preparation & Cell Culture - Human adult dental pulp cells (P.4, explant culture) from molar teeth were seeded in PEGDA (10kDa, 4.02% w/v) solution at 4.8 million cells/mL, injected into the pulp chamber of sectioned adult molar teeth, photo-polymerized with 0.1% (w/v) Irgacure2959 under UV light (365nm), and maintained in fully supplemented medium with ascorbic acid. Monolayer cell culture served as control group.

Endpoint Analyses - Samples were analyzed at 7 and 28 days for cell viability (n = 2), cell proliferation (n=6), collagen content (n=6), alkaline phosphatase (ALP) activity (n=6) and collagen deposition (n=6).

Statistical Analysis - Two-way ANOVA and the Turkey-Kramer post-hoc test were used for all pair-wise comparisons (p<0.05 *over time, ^between groups).

Results: The round cellular morphology of dental pulp cells did not change for all groups over time. Pulpal cells exhibited round cellular morphology. Live and dead staining of the cells exhibited an apparent decrease in cell viability over time. The cell number of the explant group decreased significantly from day 7 to day 28. A significant increase in alkaline phosphatase activity per cell was observed over time. ALP activity in the explant group was also significantly higher than in the monolayer on day 28. Collagen deposition per wet weight showed an increase, but there was no significant change.

Discussion: The results of this study suggest that in a tooth organ model, which stimulates the clinical situation, PEGDA-based hydrogels provide an environment that supports dental pulp cell biosynthesis. Published studies on PEG hydrogels demonstrate that the macroporous hydrogel environment upregulates osteogenic cellular signaling. This suggests that the macroporous PEGDA hydrogel was conducive to pulpal cell mineral deposition. Although there was significant mineral deposition, the increase in collagen deposition was not significant as PEGDA offers little biorecognition for the cells. Addition of adhesive peptides to PEG hydrogels has shown to increase collagen and matrix deposition. The lack of attachment sites within the gel may also explain why cell spreading was not observed in Live or Dead staining of the cells. Dental pulp cells, which have been shown to be stellate in shape, appeared rounded in this study. Further studies will be needed to evaluate the potential role of utilizing cell-adhesive proteins in PEG hydrogels for pulp tissue regeneration. In the current study, there was a significant reduction in the number of viable cells. Morphological constraints in the PEGDA hydrogel may have affected pulpal cell survival. Morphological constrains can cause human dental pulp cells to undergo transdifferentiation, and some cells are induced towards apoptosis due to harsher environmental conditions. Future studies are required to allow further augmentation of tissue regeneration, by modulating the structural properties of hydrogels, and for in vivo scaffold validation for pulp tissue regeneration.

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Analysis of ACL Fibrocartilage in Estrogen Receptor Beta Deficient Mice

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Introduction: Non-contact anterior cruciate ligament (ACL) tears are 2-8 times more likely to occur in females than males. The reason for this is likely multifactorial and is believed to include hormonal sex differences. Previous studies have shown that estrogen receptor beta deficient mice have an increase in the size of the growth plates and in the TMJ condyles. The fibrocartilage insertion of the ACL into the femur exhibits growth plate like characteristics. Therefore, it is our hypothesis that this interface will increase in size similar to the increased size of the growth plates.

Materials and Methods: For this study, 49-day old mice, WT and ER Beta KO, male and female mice were examined. Histology was performed and samples were stained with Safranin O. Quantification for the fibrocartilage attachment, total volume, total cell volume, total area, cell number, total perimeter, bone contact perimeter, cells per column and number of cell columns was calculated using the BIOQUANT Osteo software.

Results: The ACL fibrocartilage insertion was smaller in the 49-day old female ER Beta KO mice compared Wild-type controls. Specifically, total volume, total cell volume, total cells divided by total volume, cell number, total perimeter, and cells per column all were statistically significant decreased in the female ER beta KO mice compared to sex match controls.

Conclusion: There were significant differences in female but not male mice compared to sex match controls. Surprisingly, the differences all were all decreased. We have previously found that ER beta activation prevents hypertrophic maturation, which may help explain the difference. It may be possible that estrogen contributes to the size of the insertion differently than it affects the growth plate.

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Effects of Estrogen on Mandibular Condylar Cartilage Growth and Proliferation
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Introduction:
The mechanisms that regulate the development and differentiation of the mandibular condylar cartilage are intricate and currently not entirely understood. Estrogen plays a large role in regulating mandibular growth and differentiation. For example, ovariectomy (estrogen deficiency) causes increased growth of mandibular condylar cartilage that is reversed by estrogen supplementation. The mandibular cartilage is derived from the outer surface of the mandibular bone, called the periosteum. The chondrocytes specifically derive from the inner cambium layer of the periosteum, and then go on to proliferate into 4 chondral layers (superior articular [S layer], polymorphic + flattened [F layer], and hypertrophic [H layer]). There are two classical estrogen receptors here, and . Our central hypothesis is that estrogen acts through ER to inhibit chondrocyte maturation in the mandibular condylar cartilage in female mice.

Objective:
The objective of this study is to examine the role of estrogen via the ER pathway in regulating mandibular condylar growth in female WT and ER deficient mice. To achieve this aim, the mandibular condyle size along with the polymorphic cell growth and maturation from sham or ovariectomized WT and ER deficient female mice treated (or not treated) with estrogen has been analyzed and documented.

Materials & Methods:
Twenty-one day-old WT and ER deficient female mice were divided into three groups and sacrificed when they are 49 days old. The groups consisted of:
1) Wild Type (sham), 2) Ovariectomy, 3) Ovariectomy+ Estrogen
Once the mice were sacrificed, histological slides of their temporomandibular joints were made and the cells within the four chondral layers are then counted. In order to assess proliferation, BrdU immunohistochemistry was performed and the percentage of BrdU positive cells over total cell numbers was calculated.

Results & Conclusions:
We found that ovariectomy caused a significant increase in total cell numbers in the mandibular condylar cartilage that was reversed with estrogen supplementation in WT mice. On the other hand, ovariectomy plus estrogen replacement had no significant effects on female ER KO mice. Ovariectomy causes significant decrease in proliferation in both WT and ER KO compared to sham operated controls.

Discussion:
Previous studies have shown that ovariectomy causes a general increase in mandibular condylar cartilage size. In our study, we found similar results. However, when we performed ovariectomies on ER KO mice, no increase in condylar cartilage size was noted. Taken together, these results suggest that the effects of estrogen on condylar cartilage size are mainly mediated by ER receptor.

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Analysis of IRF6 Mutations in Colombian Families with Cleft Lip/Cleft Palate and Van der Woude Syndrome Phenotype

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Introduction: Cleft lip/cleft palate is the most common congenital orofacial defect and results from the failure of the fusion of embryonic facial and palatal processes. Although cleft lip/cleft palate is known as a multifactorial disorder with both environmental and genetic components, clefting associated with a particular disorder known as Van der Woude syndrome (VWS) has been directly linked to mutations in IRF6 gene. Van der Woude syndrome is the most common form of syndromic orofacial clefting and consists of a triad of lower lip pits, clefts, and hypodontia with some clinical expression variations. Van der Woude Syndrome is inherited as an autosomal dominant disorder and previous studies have shown that various mutations in IRF6 causing haploinsufficiency are causative in this syndrome. IRF6 is located on 1q32.3-q41 and consists of 9 exons. IRF6 is a transcription factor expressed at high levels along the medial portion of the fusing palatal process as well as the surrounding area.

Objectives: To identify novel pathogenic mutations within IRF6 gene in Colombian families with phenotype of Van der Woude syndrome.

Materials & Methods: This study consists of patients evaluated and treated in Neiva, Colombia. More than 300 families were screened and clinically characterized, and photographs and family pedigrees were screened for phenotypic features of Van der Woude syndrome (including presence of lower lip pits). Collection of bioespecimens, blood, and tissue samples were gathered from probands during surgical repair of cleft lip/cleft palate, as well from affected and unaffected family members. Based on the clinical criteria previously described for Van der Woude syndrome, 3 families were identified for genetic evaluation of Van der Woude syndrome. Family 1 consisted of 12 individuals, 3 of whom were affected with cleft lip and/or cleft palate. Family 2 consisted of the proband, who had cleft lip/cleft palate, and his mother, who had lip pits characteristic of Van der Woude syndrome. Family 3 consisted of the proband, who had cleft palate and her mother, who was possibly affected with Van der Woude syndrome. Genomic DNA was extracted from blood and tissue samples and amplified using polymerase chain reaction (PCR). 9 primer pairs were used in order to amplify each of the 9 exons of IRF6. PCR products were then sequenced and analyzed. DNA sequence analysis was performed using Sequencher 5.1 and pathogenicity scores were calculated using PolyPhen-2.

Results: Overall, 7 single nucleotide variants and 1 novel nonsense mutation were found in the 3 probands. The nonsense Glu143X c.G427T mutation was located at position 209968716 on exon 5. This mutation was found in both the proband and the mother in family 2 and was found to be a novel mutation. In addition, pathogenicity scores for this mutation indicated it highly pathogenic (SIFT: 0.904; PP2: 0.735). Of the 7 single nucleotide variants, 5 have been suggested to contribute to cleft lip/cleft palate in the literature (rs861019, rs2235377, rs2235371, rs2235375, and rs2013162). Six single nucleotide variants were computationally predicted to be benign with only rs2235371 predicted to be possibly damaging by PolyPhen-2.

Discussion: In summary, a novel nonsense Glu143X mutation was found in the proband and mother of family 2. This mutation results in the truncation of the remainder of IRF6 and is predicted to result in nonsense mediated decay haploinsufficiency of IRF6. Considering the integral role and dosage sensitivity of IRF6 in the fusing palatal processes, this mutation is likely the cause of the failure of fusion of palatal processes resulting in cleft lip and/or cleft palate.

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Determining the Potential for a Primitive Cytosine Deaminase to Rescue an AID-/- B-Cell Phenotype

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Introduction: One critical component of the initiation of both B-cell somatic hypermutation (SHM) and class switch recombination (CSR) is Activation Induced Deaminase (AID), a protein expressed nearly exclusively in activated B-cells. AID deaminates cytidine residues of transcribed target DNA sequences, inducing mutations in S regions and V genes. Deletion or mutation of the AID gene in mouse B-cells results in failure of B-cells to undergo SHM and CSR upon proper stimulation. It is thus clear that AID is critical to B-cell maturation. Interestingly, it has been shown that there is possible involvement of a DNA cytosine deaminase member of the AID-APOBEC family in the immune diversification process of jawless vertebrates, the most primitive vertebrates. Today, lampreys and hagfish represent the only extant taxa of jawless vertebrates remaining. While adaptive immunity in jawed vertebrates involves the production of immunoglobulins, this process is fundamentally different in jawless vertebrates, which instead have variable lymphocyte receptor genes. Two cytosine deaminase genes have been identified in Petromyzon marinus (sea lamprey) that share sequence and structural similarities with the AID-APOBEC family: CDA1 (pmCDA.21) and CDA2 (pmCDA.2). Both CDAs and AID induce mutagenesis when expressed in E.coli. It is therefore possible that AID shares similar conserved functions and mechanisms with the CDAs. It thus follows that expression of either P. marinus CDA genes could possibly rescue an AID-/- phenotype and re-establish functional SHM and CSR in AID-deficient mouse B-cells. Our goal in this study was to rescue the AID-/- phenotype by transduction of CDA1 and CDA2 in AID-/- B-cells.

Materials & Methods: CDA1 and CDA2 Constructs: Forward and reverse complement primers for PCR amplification of CDA genes from a pre-existing vector construct (Novagen pET-24b) were designed. Forward primers CDA1-F and CDA2-F each included an upstream restriction site, BamHI and EcoRI, respectively. Reverse complement primers CDA1-R and CDA2-R each included a 24bp flag sequence immediately upstream of the stop codon and a terminal restriction site for XhoI. RV-CDA1 and RV-CDA2 vectors were constructed by ligating amplified genes of interest with retroviral vector pMX-IRES-GFP. Competent E. coli were transformed with vectors via electroporation and plated overnight at 37°C on LB + ampicillin. Select colonies were then grown overnight in liquid medium (LB + ampicillin). Vectors from sequencing-confirmed RV-CDA1 and RV-CDA2 clones to be used for B-cell transduction were prepared using the QIAGEN Plasmid Midi Prep Kit. Cell Culture: The Allele Phoenix Eco 293T cells were grown in DMEM with 10% FBS at 37°C and 5% CO2. Following transfection, Eco cells were grown at either 30°C or 37°C. AID-/- mouse B-cells were grown in RPMI1640 with 10% FBS at 37°C and 5% CO2. Transfection and Infection: The Eco cell system was used to package vectors RV-CDA1 and RV-CDA2 into retroviruses. GFP imaging was used to determine Eco cell transfection efficiency. Cell culture supernatant containing retroviruses with RV-GFP, RV-CDA1, RV-CDA2, or RV-AID was used to infect AID-/- mouse B-cells. Transduced B-cells were grown at 37°C.

Protein Preparation and Western Blot: Western blot was used to confirm presence of CDA downstream flag and GFP in transfected Eco cells grown at 37°C and 30°C as well as in transduced AID-/- B-cells. Cells were lysed in RIPA buffer and following extraction of protein via TCA precipitation, samples were loaded into a 12% SDS-PAGE gel. Following gel electrophoresis, immunodetection was done using rabbit α-Flag and α-GFP primary antibodies followed by application of HRP-conjugated α-rabbit secondary antibody. Class Switch Recombination Assay: Each of the four AID-/- B-cell groups was stimulated with LPS and IL4 for IgG1 CSR at 37°C for 72 hours. BD Pharmagen APC-conjugated Rat α-Mouse IgG1 antibody was used for immunofluorescent staining of IgG1. Flow cytometry was used to determine expression levels of GFP and IgG1 in the RV-GFP, RV-CDA1, RV-CDA2, and RV-AID transduced AID-/- B-cells.

Results & Conclusion: GFP Fluorescent imaging of RV-CDA1 and RV-CDA2 transduced Eco cell groups indicated successful transfection of the Eco cell line and expression of the downstream GFP. Western blot of Eco cell lysates confirmed the presence of GFP expression and thus successful transfection of the Eco cells. However, there was a lack of detectable expression of CDA1 for Eco cells grown at both 30°C and 37°C. CDA2 was more strongly detected in Eco cells grown at 30°C than at 37°C. Following infection of AID-/- mouse B-cells, western blot of the four B-cell group lysates confirmed GFP expression in all four groups and thus successful infection of B-cells. However, C-terminus flag expression could not be detected in either the RV-CDA1 or RV-CDA2 groups. Flow cytometry following the CSR assay revealed GFP expression without IgG1 expression for negative control group RV-GFP and both GFP and IgG1 expression for positive control group RV-AID, as expected. Both RV-CDA1 and RV-CDA2 groups showed GFP expression but no IgG1 expression following the CSR stimulation. Ultimately, neither CDA1 nor CDA2 transduction of AID-/- B-cells in this particular experiment was able to rescue the blocked CSR aspect of the AID-/- phenotype.

Discussion: The results of the western blot of transfected Eco cell lysates indicate distinct temperature sensitivity in the expression of CDA2 and likely also CDA1. It is probable that the two primitive lamprey CDAs are unstable at the higher temperatures suitable for mammalian cell cultures. Detection of GFP but not the C-terminal flag in RV-CDA1 and RV-CDA2 transduced B-cell lysates by western blot further indicate a lack of CDA presence due to either instability of these two proteins at 37°C or a lack of expression. In this case, regardless of catalytic similarities between CDA and AID, without a means to express stable CDA proteins at detectable levels it would not be possible to meaningfully determine if CDA could rescue an AID-/- B-cell phenotype. DNA from the infected B-cells has yet to be analyzed for SHM due to time constraints. Thus, this is a logical next step to this project. Perhaps more importantly though is addressing the issue of inadequate expression of a stable CDA1 or CDA2 protein. Improving temperature stability of the proteins and enhancing mammalian expression by codon optimization, in which codons in the CDA genes with low frequency in mice are replaced with codons of high frequency in mice coding for the same amino acid, will allow for a more meaningful assessment of lamprey CDA proteins’ effects on CSR and SHM and their ability to rescue the AID-/- B-cell phenotype.
Does the Inverted Repeat Region Near the Promoter Affect Tight Adherence (tad) Locus Expression in Aggregatibacter actinomycetemcomitans?

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Introduction: Aggregatibacter actinomycetemcomitans (Aa) is a Gram-negative bacterium known as the predominant etiologic factor for Localized Aggressive Periodontitis (LAP). This bacterium has the ability to form tightly adherent biofilms on inert surfaces. The tad locus is essential for this bacterium to colonize the oral cavity and cause disease. The reason for the tenacious adherence is found in Flp pili. The tad locus must be expressed for Flp pili to be made. A possible reason for the production of temporarily nonadherent cells needed to allow the biofilm to grow is the inhibition of tad locus expression. The focus of the study is a 31 base pair inverted repeat (IR) region adjacent to the tad promoter. It is a region of interest with a currently unknown function. It has been hypothesized to be a binding site for a repressor protein that inhibits tad transcription.

Objectives: The study aims to test whether a deletion of the IR region in Aa would affect expression of the tad locus and subsequent phenotypic changes.

Materials & Methods: We used the vector excision (VEX) method, a method to make a specific chromosomal deletion. We used the vector excision (VEX) method, a method to make a specific chromosomal deletion that has no effect on the expression of downstream genes, by the protocol put forth by Figurski et al. A cycle of homologous recombination was used to form a double cointegrate. In the experiment, a cassette with two directly repeated loxP sequences (loxPx2) was first cloned into a pACYC177 plasmid. The loxPx2 cassette was marked by the aacC1 gene for gentamicin resistance on the left side and by the aadA gene on the right side. The loxPx2 cassette and two homology regions were sequentially cloned into contiguous non-essential sites of the pACYC177 plasmid: (1) homology region I (HRI) contains a ~500-bp sequence upstream the IR region, (2) the loxPx2 cassette, and (3) homology region II (HRII) contains the a ~500-bp sequence downstream of the IR region. The three fragments were cloned by PCR using the following restriction enzymes: PsI and EcoO1091 for fragment (1), EcoO1091 and Scal for fragment (2), and Scal and PsI for fragment (3). This double-loxP construct was then cloned into the pMB78 plasmid, a “suicide” plasmid that can replicate in E. coli but not in Aa. pMB78 contains an uptake signal sequence (USS) necessary for the transformation into Aa. The double-loxP construct was then introduced into DF2261N (Tad⁻) and DF2200N (Tad⁺) cells by transformation.

Results & Conclusions: We aimed to test the functional capability of the IR region in the tight adherence (tad) locus of Aa using plasmids as a substrate for recombineering and the new Vector Excision (VEX) method as a strategy for making a precise genomic deletion of the 31 base pair IR region. Aa transformants were not found. This could potentially demonstrate the importance of the IR region near the tad promoter because the phenotype may have been lethal. However, it is still inconclusive as to whether or not the IR is involved in the transcriptional control of the promoter. Cre-mediated deletion for resolution and phenotypic assay, for colony morphology, aggregation, and biofilm, were not performed due to the lack of transformants.

Discussion: Having arrived at a point where the deletion of the IR led to the inability to form Aa transformants, we must attempt to lead the study in an additional direction to substantiate the importance of the region itself. We aim to make a similar construct placing the loxP sequences in different locations. By placing one loxP sequence between the tad promoter and the IR and one loxP sequence in front of the flp-1 gene, the first gene of the tad operon, we will still be essentially trying to delete the IR. However, in the future study, we will not delete the IR region until the single loxP transformants have been made. We will then attempt to delete the IR region using Cre-mediated recombination and assay for phenotypic changes. If the study finds that the transformants cannot be made after Cre-mediated resolution, then it is further evidence for the essentiality of the IR region. If we are able to both successfully delete the IR region and form transformants, in addition to assaying for phenotypic changes, both transcriptional and translational lacZ reporters will be used to assay whether or not the region is affecting the tad gene expression at the transcriptional or translational level. Also, biochemical tools can be applied to detect a protein, small RNA, or small molecule that is involved in the mechanism of gene regulation in the tad locus.

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Effect of Forced Mouth Opening on Murine TMJ
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Introduction: TMJ disease predominantly afflicts women of childbearing age, suggesting a female hormonal component to the disease process. This project examined if estrogen inhibition of mechanical loading-induced periosteal bone formation occurs in the periosteal derived TMJ.

Materials and Methods: Mechanical force was implemented by placing a spring calibrated to exert 0.5N when placed between incisors (forced mouth opening). Spring was placed for one hour a day for five consecutive days.

The mice were divided into four groups:

1. Female mice with no manipulation (n=3)
2. Male mice with no manipulation (n=4)
3. Female mice undergoing forced mouth opening (n=3)
4. Male mice undergoing forced mouth opening (n=5)

Mice in all four groups were sedated with ketamine during the one hour period of either forced mouth opening or no manipulation. BrdU was injected three hours prior to sacrifice on the fifth day of the experiment. Histology sections of five micrometers were prepared. Immunohistochemistry for BrdU and Tieg1 were done to yield ratio of positive cells to total cells.

Results: Forced mouth opening caused a significant increase in cell count in male mice but not in female mice compared to sex-matched no manipulation controls. On the other hand, forced mouth opening did not cause any differences in proliferation as measured by BrdU compared to sex matched controls. Future studies are planned to examine apoptosis.

Conclusion: Similar to periosteal bone, we found decreased TMJ mechanosensitivity in sexually mature female mice compared to male mice. The decrease in mechanosensitivity in females may provide clues into the gender predilection of TMJ disorders.

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Exosomes Mediate Dental Epithelial and Mesenchymal Cells Crosstalk During Odontogenesis

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Introduction: Exosomes are small vesicular structures averaging 40-120 nm in diameter and are distinguished by their formation within cellular endosomal compartments known as multivesicular bodies (MVBs). Initially described in 1983, exosomes only recently became the subject of intense study due to the discovery of their significant role in intercellular communication. It is now well established that exosomes are secreted by most cell types and carry molecular messages through combinations of proteins, mRNA, and miRNA specific to the cellular source. Odontogenesis, or tooth development, involves an intricate sequence of reciprocal signaling between dental epithelial and dental mesenchymal cells that is only partly understood. In a classic study by Theslef et al. to elucidate the mechanism for signal transmission in early odontogenesis, it was demonstrated that interposition of a nucleopore filter with pore size >200-nm would permit normal cytodifferentiation of odontoblasts and ameloblasts whereas pore size of 100-nm prevented cytodifferentiation. Theslef had concluded from the findings that juxtacrine (contact-dependent) signaling must be the sole means of intercellular communication because diffusible signals would have traversed the smaller pores had they been present. In light of more recent discoveries, we speculate that exosomes may play a critical role in dental epithelial-mesenchymal interactions. This study investigates the protein and micro-RNA contents of exosome secreted by dental epithelial and mesenchymal cells. Our results reveal that exosomes may act as signaling mediators in tooth development.

Objective: To test the hypothesis that dental epithelial and mesenchymal cells secrete exosomes as vehicles for intercellular signaling during odontogenesis.

Materials & Methods: Dental epithelial and mesenchymal tissues were isolated from 4-5 days old rat under dissection microscope. Cells were then propagated in exosome free media. The supernatant was harvested and exosomes secreted by both cell types were isolated using ExoQuick exosome precipitation reagent (SBI). Proteins were extracted and separated by SDS-page gel, followed by silver staining. Bands were cut from the gel according to molecular weight, and analyzed by mass spectrometry. Total RNA was extracted using Trizol®. MicroRNA components were analyzed by RNATM Universal RT microRNA PCR Services (Exiqon).

Results & Conclusions: 1) Nanoparticle Tracking Analysis (NTA) showed that average diameter of particles purified from dental epithelial and mesenchymal cell cultures was 119 nm, falling within the accepted range of exosome size. 2) Expression of CD63, a putative exosome marker, was confirmed by Western blot. 3) Characterization of exosome proteins yielded two proteins of interest, Cofilin-1 and Periostin, which are involved in actin-modulation and odontogenesis, respectively. 4) Over a hundred micro-RNAs were detected in exosomes. Compared to the microRNA profile in parental cells, miR-23a and miR-150, which are micro-RNAs that regulate tooth development and angiogenesis respectively, are enriched in exosomes. 5) Preliminary data from the differentiation analysis experiments indicate a 20-fold increase in Dspp (dentin sialophosphoprotein) gene expression in dental mesenchymal cells when exposed to varying dosages of dental epithelial exosomes as compared to control cell groups.

Discussion: Our findings suggest that exosomes contribute to epithelial-mesenchymal dialogue during odontogenesis. Additional studies are being designed to investigate the mechanism of odontogenic exosomal mRNA and miRNA action in effector cells. These discoveries will shed light on aspects of odontogenesis that are poorly understood and may have significant impact in context of dental tissue engineering.

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Maxillary Sinus Augmentation and Vitamin D Insufficiency- a Systemic-Local Connection  
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Introduction: Implant placement in the edentulous maxilla often represents a clinical challenge due to insufficient bone height after crestal bone resorption and maxillary sinus pneumatization. Tatum et al was the first one describing a procedure, which utilizes existing space in the maxillary sinus by lifting up the Schneiderian membrane from its bony surface and filling this newly created space with augmentation material. Several grafting materials can be used to augment bone height in the posterior maxilla: autogenous bone, allografts (harvested from human cadavers), alloplasts (synthetic materials), and xenografts (grafts from nonhuman species). After graft placement, particles will partially be remodeled and replaced by the patient’s own bone. This process is a complex mechanism and influenced by several factors associated with overall bone metabolism.

Vitamin D plays an essential role in calcium homeostasis and is essential for bone formation and remodeling. It promotes coupling of bone resorption to bone formation on a cellular level and, therefore, optimizes bone remodeling. Whether low vitamin D serum levels are associated with less bone remodeling after maxillary sinus augmentation has not been evaluated.

Objective: This pilot cohort study will investigate bone formation and remodeling after sinus augmentation and determine Vitamin D levels throughout the treatment.

Materials & Methods: Patients (age: 48.6±12.6, 28.2±5.1) underwent sinus augmentation surgery using β-tri-calcium phosphate as a grafting material (n=20). 24 weeks after sinus augmentation, implants were placed and a bone core was harvested from the same site. The bone core was analyzed histologically and histomorphometrically to evaluate bone regeneration and remodeling within the sinus graft. Blood samples were collected at the baseline visit and after 2, 12 and 24 weeks to determine serum levels of calcium and 25-hydroxyvitamin D (25-OHD). The association between 25-OHD serum levels and bone regeneration in the grafted sinus was analyzed.

Results & Conclusions: Patients with deficient Vitamin D levels (25 (OH) D: <30ng/ml) had lower bone content in their bone biopsies than patients with sufficient Vitamin D levels (25 (OH) D: >30ng/ml) (41.13±4 vs. 48.8±3.6 % of total area), whereas the amount of remaining graft material was higher in Vitamin D insufficient patients (16.1±6 vs. 13.9±2.6 % of total area). In line with these findings, more osteoclasts were detected around bone and graft particles in bone cores taken from the Vitamin D sufficient patient group (1.7±0.5 vs 2.6±0.7 (bone), 1.89±0.75 vs 2.71±1.05 (graft).

Discussion: Our findings suggest that sufficient Vitamin D serum levels might be advantageous for bone remodelling after maxillary sinus augmentation. Bone biopsies taken from patients with insufficient Vitamin D levels were less metabolically active and had less bone and more remaining graft material. Several studies have demonstrated that vitamin D supplementation increases bone mineral density. Therefore, future studies could evaluate whether Vitamin D supplementation might improve bone formation after sinus grafting.

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Improving TMJ Regeneration
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Introduction: Loss of TMJ tissue due to injury or chronic degeneration can lead to TMJ dysfunction and severe pain. Current treatment modalities for TMJ injury/degeneration are limited and there are no biological treatments that regenerate TMJ tissues. Stem cell-based regenerative medicine has the potential to repair or replace damaged tissues with physiologically functional tissue. Mesenchymal stem cells (MSCs) are multipotent stromal cells that can differentiate into multiple tissues including bone, fat, and cartilage. The presence of these multipotent stem cells in TMJ tissues is unknown. Therefore, development of a TMJ injury/degenerated model is crucial to test the efficacy of potential stem cell-based TMJ regenerative therapies. The use of non-rodent, pre-clinical animal models is also critical to determine stem cell-based TMJ regeneration strategies for human clinical trials.

Objectives: We proposed to develop both a surgical TMJ injury model and a regeneration model using female New Zealand White rabbits. We also proposed to determine whether the rabbit TMJ condyles harbor multi-potent stem cells that can be used for TMJ stem cell-based tissue regeneration.

Materials/Methods: For the TMJ injury model, four month-old New Zealand white rabbits were subjected to unilateral TMJ disc perforation. After each rabbit was anesthetized, the pre-auricular region of the rabbit was shaved and prepped under sterile conditions. To surgically access the superior joint space, a 1-2 cm incision was made along the lateral upper border of the zygomatic arch to directly expose the TMJ disc. A punch biopsy was used to create a 2.5 mm perforation in the TMJ unilaterally. Sham surgery was performed on the contralateral side. Each side was sutured similarly. Radiographic examination and phlebotomy were performed both at the time of surgery and time of euthanization (two, four, eight weeks). Gross pathological, histological, and SEM evaluation were performed on the rabbit TMJ condyles. For the TMJ regeneration model, the anatomic contour of a cadaver TMJ condyle on the right side of a New Zealand White rabbit was captured from multi-slice laser and reconstructed by computer aided design (CAD). Anatomically correct TMJ scaffolds of polycaprolactone (PCL) were fabricated by three-dimensional bioprinting. The native rabbit TMJ condyle and condylar neck were surgically excised and scaffolds were immediately implanted without cells. In a parallel study, primary TMJ cells (TMJCs) were isolated from rabbit TMJ condyles. TMJCs were characterized using RT-PCR, colony-forming assay, and examined for multipotency, using donor-matched MSCs isolated from tibia bone marrow as comparison controls.

Results: In the injury model, gross morphological examination revealed an irregular condyle surface and hyperplastic disc at two weeks compared to sham control. At four weeks, the injury model demonstrated an increasingly irregular surface and enlarged condyle. By eight weeks, the condyle appeared inflamed and erythematic with severely irregular surface relative to sham control. SEM analysis showed disarrayed collagen fibrils on condyle surface, while sham control showed smooth condyle surface. In the regeneration model, surgically placed scaffolds in rabbits were stable eight weeks post-operatively. RT-PCR analysis showed TMJCs had distinct gene expression profiles compared to donor-matched MSCs. As seen in chemical-defined media, TMJCs underwent osteogenesis, adipogenesis, and chondrogenesis in pellet cultures. TMJCs formed single-cell colonies by colony-forming assay similar to MSCs.

Conclusion: TMJ condyles harbor distinct stem/progenitor-like cells that may participate in TMJ tissue homeostasis and regeneration. The long-term inflammatory nature of our TMJ injury model mimics the human condition and may be accurate in simulating human TMJ degeneration. The stability of our regenerative models also suggests that regenerative scaffolds may be useful in exploring novel approaches for TMJ repair.
Oral Cancer Risk Assessment: A Survey of Dental Schools
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Introduction: Though it account for just 2% (females)-3% (males) of all cancers, Oral Squamous Cell Carcinoma (OSCC) has one of the lowest five-year survival rates as compared with other major cancers. The odds of survival increase from a low 26% for patients with Stage 4 OSCC to 85% for patients with Stage 1 OSCC. Current risk assessment practices have not been effective in detecting OSCC in its early stages. Most early lesions are asymptomatic, contributing to why approximately 65% of patients are diagnosed at stages III or IV of the disease.

Objective: Our long-term goal of this project is to introduce the science of risk assessment as a major educational requirement of predoctoral dental students and to eventually lead to increased utilization while in the Dental School environment to prepare students to more efficiently and effectively diagnose OSCC at an earlier stage.

Materials and Methods: One of the major resources that we are using for this task is the knowledge of the professors of oral pathology and oral medicine who are currently teaching the predoctoral students. With their help, we have gone about collecting information in the form of a survey to begin to understand the opportunities for improvement in current practices. The results of this survey helped us to develop an algorithm that indicates risk assessment. We developed the first draft of a risk algorithm that is currently being pilot tested in dental clinics at Columbia University. Patients will be evaluated on a broad variety of risk factors including alcohol consumption and quantity, tobacco use and quantity, quantity of partners on whom the patient has performed oral sex, consumption of various food such as fruits, vegetables, dairy products, seafood, and meat products, and high-risk occupations. We will continue to evaluate and adapt our processes accordingly.

Additionally, we included an open-answer section to our survey that encouraged faculty members to opine on the strengths and weaknesses of their curriculum as well as to discuss different obstacles that they feel are present in oral cancer assessment. This section also allows responders to further clarify previous answers, which increases their value in modifying our algorithm.

Results and Conclusions: There were several areas for opportunity that were a source of focus for a large percentage of the dentists polled. While a majority felt that each dental student did a routine check for suspicious lesions as part of standard protocol, many felt that graduating students were not capable of actually recognizing a malignant lesion. An even larger percentage felt that graduating students were not capable of recognizing a pre-malignant lesion. Almost half of the polled dentists felt that graduating students did not sufficiently discuss oral cancer prevention with “high-risk” patients. 50% of all polled did not believe that graduating dentists had received sufficient education in smoking cessation and 47.5% felt that there was insufficient training in alcohol abuse cessation. 65% of dentists polled felt that students graduated without a proper understanding of the cost versus benefit of oral cancer screening.

Discussion: It is our aim to approach improvements to pre-doctoral curricula from a scientific perspective as opposed to simply a seemingly logical one. This is an ongoing process that will require continued revision of the algorithm. Based on the continually revised results of our meta-analyses identifying an expanded list of risk factors, our ongoing interactions with oral pathology and medicine professors, and continued research to better understand the barriers to effective risk assessment, we will continue to evaluate and adapt our processes accordingly.

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The Inter-Relationships among the Oral Complications of Diabetes Mellitus

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Introduction: Diabetes mellitus (DM) is a common systemic disease with a significant impact on the oral cavity. Periodontal disease has been established as the primary oral complication of diabetes. Other oral manifestations include dental caries, xerostomia, reduced salivary flow, Candida infection, burning mouth syndrome, benign parotid hypertrophy, and poor dental implant outcomes.

Objectives: The purpose of this comprehensive literature review is to determine the prevalence of these oral manifestations and to establish the inter-relationships between them.

Methods: The dental literature was searched using the PubMed database. Specific key terms and different combinations of terms were used to evaluate titles, abstracts, and full articles to identify articles relevant to this review. Articles published after 1990 in English (or with an English summary) were included. Relevant references from the identified articles were also evaluated and when appropriate were included in this review.

Results and Conclusions: The literature on oral manifestations of DM demonstrates that these disorders are common co-morbidities in patients with diabetes, often occur together, and may exacerbate each other. A number of interesting associations were identified. Reduced salivary flow will influence the development of root surface caries, Candida infection, and burning mouth syndrome. Periodontal disease links to root surface caries (increased prevalence of periodontitis and attachment loss), and mechanistically to accelerated tooth eruption. Implant outcomes in diabetic patients is an important topic, but there is limited evidence about outcomes. Altered bone metabolism, neuropathy, and xerogenic medications are associated with DM and may contribute to oral manifestations. Diabetic neuropathy, experienced later in the progression of DM, may be responsible for enhancing the oral manifestations of DM. The sequelae include reduced salivary flow, burning mouth syndrome, and benign parotid hypertrophy. While some of these relationships are well defined, others are proposed and need further study.

Discussion: A comprehensive review of the literature examining the oral manifestations of diabetes mellitus can help identify associations between these lesions as well as their relationship to medical complications. Understanding these relationships can help with patient management. While this work suggests certain associations, some of the findings require further investigation.
Prevalence of Dental Anxiety in the Washington Heights Adult Community
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Introduction: Dental anxiety serves as an impediment to dental treatment, with an estimated 20 to 40 million American adults affected. In fact, 5-10% of adults are classified as dentally phobic, rendering them so fearful that they only seek dental care for emergency treatment. From the perspective of the practitioner, dental fear is the most cited problem with 57% of dentists claiming that it is the most stressful factor in their practices.

Objectives: This study aims to determine the prevalence of dental anxiety in the Washington Heights adult community, while investigating potential gender differences and time since last dental visit.

Materials & Methods: Corah’s Modified Dental Anxiety Scale (MDAS) is a five-item questionnaire widely used to identify dental anxiety and possible phobia. We included two additional items to indicate gender and time since last dental visit for comparative purposes. The MDAS and consent form were available in English and Spanish. A colleague, with Spanish as her first language, verified the translation to ensure proper interpretation and questionnaire validity. Surveys were distributed at Columbia University Medical Center to individuals 18 years and older in the waiting rooms of the Associates in Internal Medicine Practice and at various community events. After obtaining informed consent, subjects were given a questionnaire to complete anonymously. Incomplete questionnaires were discarded. MDAS scores range from 5 to 25, with a score of 19 or above indicating a highly dentally anxious and potentially phobic individual.

Results: Of the 393 participants, 72% identified as female, while 28% identified as male. Regarding time since the last dental visit, 56.2% visited within the past 12 months, 25.4% visited 1-2 years ago, 10.2% visited 2-5 years ago, 5.9% over 5 years ago, and 2.3% have never visited the dentist. Cronbach’s alpha was calculated and the MDAS was determined a reliable measure for this sample (\( \alpha = 0.86 \)). Participants had a mean MDAS score of 12.8 (SD = 5.4), with 17.6% scoring above 19. We found that females (\( M = 13.26, SD = 5.56 \)) had a significantly higher mean MDAS score than males (\( M = 11.60, SD = 4.94; t (391) = -2.74, p < 0.05 \)). We performed a one-way ANOVA and found that the times since last dental visit had a significant difference in mean MDAS score (\( F (4, 338) = 3.428, p < .05 \)). Post hoc analyses using the LSD post hoc criterion for significance indicated that the MDAS score was significantly higher in those that last visited the dentist “over 5 years ago” (\( M = 16.17, SD = 6.18 \)) than in those that had their last visit “within past 12 months” (\( M = 12.15, SD = 5.36, p = .001 \)), “1-2 years ago (\( M = 13.32, SD = 5.29, p = .022 \)), and “2-5 years ago” (\( M = 12.78, SD = 4.49, p = .016 \)).

Discussion: The prevalence of highly dentally anxious, possibly phobic individuals in the Washington Heights adult community is 17.6%, indicated by a MDAS score above 19. This is considerably greater than the national prevalence of 5-10%. Females demonstrated significantly higher dental anxiety than males. The higher mean anxiety score among those who last visited the dentist over five years ago suggests anxiety as a possible contributor to the avoidance behavior. Because this study has demonstrated the presence of a significant proportion of dentally anxious individuals in our community, above the national average, the results deserve recognition. This may necessitate the need for further investigation, and the initiation of a clinical setting within Columbia University to better meet the special needs of our patient population.

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Addressing Access to Care: An Analysis of East Coast State Dental Practice Acts
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Introduction: Across the U.S., states recognize limitations in access to dental care, particularly for low-income populations. States are able to use their practice acts to facilitate expanded access through several strategies. Prior to initiating this study, 17 strategies were identified including expanded functions of ancillary providers, the creation of new provider types, volunteerism, foreign dentist licensure, mobile dentistry, and increased ownership allowances. This study examines the texts of 16 East Coast practice act statutes in order to identify those states that have incorporated any of these concepts.

Methods: The majority of practice acts were found through an internet search. Links to the Statutes were typically located on the corresponding state dental society home page. Most acts included Statutes, Rules, and Regulations. However, this study only examined the Statutes, so any remaining policy was disregarded. Because each practice act was lengthy, a targeted keyword search was used in order to gather language of interest. If keywords did not result in matches, a full reading was completed, with particular attention to section subtitles.

Results: All 16 Practice Acts were identified. Two states provided separate practice acts for dentists and dental hygienists. However, the majority were presented within one consolidated document. Five required more extensive searches to the respective state general professional licensure site. Out of 17 strategies, East Coast states adopted an average of four, ranging from Delaware incorporating two, and Maine, Massachusetts, and Virginia endorsing seven strategies. Overall, 13/14 states had provisions that give volunteer permits for out-of-state practitioners to treat indigent populations. Twelve states have policies allowing dental hygienists to have expanded roles with lesser supervision, specifically in the safety net setting. Furthermore, in regards to foreign-trained dentists, six states promote practice in the safety net, nine give teaching and practice privileges in the university setting, and seven grant general licensure. Lastly, four states address licensure requirements for mobile dentistry, and six permit non-dental entities to own practices. Unique findings include the creation of new roles: the Independent Practice Dental Hygienist and the Expanded Function Dental Assistant.

Discussion: Dental practice acts aim to self-regulate the profession, protecting the public’s health by moderating and enforcing the standard and delivery of care. Each state has a unique set of allowances, however, general trends exist. For example, there are strict rules pertaining to who can practice in the state, especially regarding foreign dentists. Many states give permission to work in safety net and university settings – expanding access to care – however, limiting their ability to operate privately. In addition, volunteer permits for non-resident dentists typically last no longer than a few months, ultimately protecting resident providers. There is also an emphasis on “general” and “direct” supervision, often with a listing of procedures that auxiliaries can and cannot perform. This strict delineation may hinder access to care, but states have made efforts to liberalize requirements in public health settings that serve vulnerable populations. As a result, hygienists and assistants can perform basic tasks without the presence of a dentist, and some states allow for higher levels of reversible treatment. In fact, though few in number, states are starting to give licenses for expanded functions, which could ultimately promote more care for more patients. There has also been a pattern in ownership allowances. Traditionally, a dentist can individually or group-own only a practice. However, several states now allow hospitals, non-profits, and public entities to own or contract with dentists to own facilities. In addition, one dentist may own several practices. This paradigm has the potential to provide care in previously neglected areas.

Conclusion: According to the design of this study, every state Statute included at least one policy that enhances access to care. However, there was no state that achieved half or more of the pre-determined strategies. It must be noted, though, that some actions may have fallen within Rules and Regulations. In order to better assess how states are handling access issues, a full 50 state analysis is in progress. Results will uncover policies that either enable or inhibit the ability to serve vulnerable populations. This information will ultimately be used in creating new legislation that better provides safe, yet more expansive care.

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Survey Development and Evaluation Using the Technology Acceptance Model and the Diffusion of Innovations Model

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Introduction: Prior research has shown that computer-mediated clinical decision support systems (CDSS) can assist clinicians in making evidence-based decisions regarding patient care. The Dental Tobacco Cessation System (DEN-TC) is a CDSS intended to support the adoption of evidence-based tobacco cessation guidelines (the 5 A’s: Ask, Advise, Assess, Assist and Arrange) (Fiore et al., 2008) in the dental office. A pilot study is planned in five dental offices in which dental clinicians, dental assistants, and office staff will be surveyed regarding their opinions and knowledge of technology and tobacco cessation. Development of the survey instrument was informed by the Technology Acceptance Model (TAM) (Davis, 1989) and Rogers’ Diffusion of Innovations (DOI) model (Rogers, 2003, Dearing, 2008). TAM purports that the perceived usefulness and ease of use of the system predict a user’s attitude toward the technology, their resulting behavioral intentions and actual usage (Venkatesh and Davis, 2000). The five stages through which individuals evaluate and ultimately determine whether or not to adopt an innovation in the DOI model are 1) knowledge, 2) persuasion, 3) decision, 4) implementation and 5) confirmation (Rogers, 2003). For this study, baseline surveys were designed to assess respondents’ knowledge.

Objective: A baseline survey instrument was developed and evaluated, utilizing the TAM and DOI models, to gauge clinicians’ knowledge, opinions and practices with technology and tobacco cessation counseling in the dental office. The survey instrument was piloted with thirty dentists and dental hygienists. Four months after the DEN-TC intervention, a follow-up survey will measure change in knowledge and opinions as well as interest in utilizing this technology to implement tobacco cessation activities with patients in their dental practice.

Materials and Methods: Potential survey questions were drafted for the baseline and follow-up surveys. In addition, validated questions from prior tobacco cessation and technology assessment surveys were modified to comply with DOI and TAM constructs. A seventeen question online survey was created and posted on the Survey Monkey website. A convenience sample of Columbia-affiliated dentists and registered dental hygienists were recruited to complete the online survey. The data was analyzed using SPSS. Reliability was assessed using a measure of internal consistency reliability, Cronbach’s alpha. Concurrent validity was also evaluated for the questions.

Results and Conclusions: 83% of respondents (n=24) viewed technology as important for dental care. 40% of clinicians (n=12) indicated that tobacco cessation activities do not take place in their dental office. Internal consistency was high, with Cronbach’s alpha scores ranging from .72 to .92. TAM-based questions on ease of use of technology and intention to use technology were both highly correlated with respondents’ actual use of electronic devices. Knowledge of tobacco cessation practices was highly correlated with respondents’ confidence in prescribing pharmacotherapeutics for tobacco cessation. Interestingly, receipt of formal training in tobacco cessation for patients was poorly correlated with knowledge of tobacco cessation practices. A few questions were ultimately revised based on these results.

Discussion: The TAM and DOI models proved useful in developing and evaluating survey instruments that assess respondents’ adoption of and intention to use certain technologies.

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The Knowledge, Attitude, and Behavior of Dental Students & Residents in Managing Anxious Patients

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Introduction: More than half of dentists cite difficult and fearful patients as the single most stressful factor in their practice. Currently, pharmacological therapy is the most common treatment form used for managing anxious patients. However, certain non-pharmacological techniques prove more effective in treating fearful patients than the use of prescription medication. As many as 91.6% of patients treated with behavioral therapy regularly attended the dentist 10 years after the beginning of their non-pharmacological intervention, as opposed to only 33.3% of fearful patients treated with general anesthesia.1

Objectives: The aim of this study is to determine the level of knowledge, attitude, and behavior among dental pre-clinical students, clinical students, and residents regarding the treatment of anxious patients in the Washington Heights community using non-pharmacological behavioral management techniques.

Materials & Methods: We developed a 40-item questionnaire to assess the knowledge, attitude and behavior that Columbia dental students and residents have towards treating anxious patients using non-pharmacological techniques. Questionnaires were distributed to first year (pre-clinical) students, fourth year (clinical students), and post-doctoral residents in seven different specialty programs. After reading a consent form and verbally agreeing to participate, subjects were handed a questionnaire to complete anonymously. The questionnaire contained three distinct parts. First, a 20-item true/false quiz tested the base level of knowledge of dental students and residents regarding general characteristics of anxious patients along with non-pharmacological therapies for treating these patients. The second category was a 10-item Likert scale that assessed how comfortable students and residents felt in dealing with anxious patients and whether or not they felt their knowledge level was adequate to treat these patients. Finally, the last 10-item category of the questionnaire identified how often clinical students and residents used different types of pharmacological and non-pharmacological techniques in treating anxious patients during practice. We included two additional items to indicate gender and whether the dental provider had a healthcare worker in their family for comparative purposes.

Results & Conclusions: Of the 148 participants, 40.7% identified as female, while 48% identified as male. 47.2% had a healthcare worker in their family while 39.2% did not. The remaining participants failed to indicate their demographic information. Out of 20 true/false questions, the average number of correct answers for all respondents was 10.01, yielding an average score of 50.1% on the knowledge section of the questionnaire (M = 10.01, SD = 3.1). The range of the number of correct answers ranged from 0 to 16 (out of a possible 20). We found no statistically significant difference among the scores of pre-clinical students (M = 9.78, SD = 3.25), clinical students (M = 10.47, SD = 3.14), or residents (M = 9.94, SD = 2.27). We found that the pediatric residents had the highest average score of all groups (M = 12.6). On average, those with healthcare workers in their family (M = 10.04, SD = 2.9) scored higher on the true/false quiz than those without (M = 9.7, SD = 3.2), although these results were not statistically significant. Males were also more likely to score higher on the true/false quiz. To assess the reliability of the attitude and behavior portions of the questionnaire, Cronbach’s alpha was calculated. We determined that this scale was a reliable measure for our sample in the attitude section (α = 0.724). In this portion of the questionnaire, the majority of participants indicated that they feel it is important to receive training in non-pharmacological behavior management techniques for anxious patients. 54.1% of students and 52.4% of residents agreed with this statement while 37.8% of students and 44.1% of residents strongly agreed. In addition, 63.2% of participants agreed that they would like to learn more regarding how to handle anxious patients, while 19.7% strongly agreed. Using Cronbach’s alpha, we found a poor internal consistency range in the behavior section of the questionnaire (α = .55). This indicates that clinical students and different residency programs use different techniques to deal with anxious patients.

Discussion: Results from this study demonstrate a severe lack of knowledge from dental students and residents regarding the demographics, needs, and non-pharmacological treatment options for dealing with anxious patients. The majority of participants surveyed also indicated a lack of comfort in their ability to treat dentally anxious patients. These results signify that dental students and residents should receive additional training in this subject area to increase awareness, knowledge, and confidence in treating fearful patients in dentistry. Our results also provide purpose for the initiation of a clinic setting within Columbia University geared towards treating fearful and phobic patients and educating dental students and dentists on non-pharmacological treatment techniques for dealing with these patients.

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Knowledge and Attitudes of Dental Students Towards Performing Research

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Introduction: Columbia University’s College of Dental Medicine (CDM) maintains a robust research program. Yet many students, especially new students, may not be aware of how to become involved in dental research. A multitude of factors can play a role in a student’s decision to conduct research. In addition to factors of knowledge, a student’s attitude and perceived expectations may also influence the decision to perform research.

Objective: 1) To learn more about the knowledge and attitudes of current CDM students towards involvement in research; 2) To identify the most influential variables in predicting involvement in a) research following dental school (MODEL 1), b) joining the Jarvie Society (MODEL 2), and c) contacting a faculty member regarding research opportunities (MODEL 3).

Materials & Methods: Study subjects were 1st-year CDM dental students (n=80). A total of 69 subjects participated (response rate = 86%). A 2-page paper questionnaire was developed to include questions and statements relating to: topics available in research, location and timing of research, the purpose of research, compliance awareness, sources of information, attitudes toward research, and website usability. Participants were asked to agree or disagree with each statement in the questionnaire, with responses ranging from 1 (strongly disagree) to 4 (strongly agree).

Results: About 59% of the participating subjects reported that they had experience in prior research. When asked about what career they would like to pursue, 66.7% are considering specializing, 21.7% are considering GPR/AEGD, and 18.8% are considering academia. Using factor analysis, 7 groupings of variables were created: 1) knowledge of people in dental research, 2) motivation by rewards and competition, 3) knowledge of locations to perform research, 4) knowledge of topics of dental research, 5) perceived importance of research, 6) positive perception of research, and 7) perceived expectations from others. Three predictive models were created in order to predict different intentions and behaviors of students, and all three models were regressed against these 7 variable groups.

MODEL 1 focused on involvement with research following dental school (R²=.45). The two most influential predictors were positive perception of research (B=.33, p=.008) and perceived importance of research (B=.27, p=.045). MODEL 2 focused on whether students join the Jarvie Society, the dental student research club at CDM (R²=.52). The three most influential predictors were perceived importance of research (B=.30, p=.019), motivation by rewards and competition (B=.30, p=.022), and perceived expectations of others (B=.26, p=.025). MODEL 3 focused on whether students contacted a faculty member regarding research opportunities (R²=.56). The three most influential predictors were knowledge of people in dental research (B=.39, p<.001), perceived expectations from others (B=.38, p<.001), and knowledge of locations to perform research (B= -.25, p=.018).

Discussion & Conclusion: These findings help identify which factors of knowledge and attitude are important to students when considering involvement in research and provide insight into how to further foster a culture of research in CDM students. MODEL 1 suggests that a student’s perceived importance and usefulness of research play a significant role when deciding to become involved in research after dental school. In order to encourage more students to continue in research after dental school, the CDM curriculum should include more material pertaining to the advantages and lifestyle of dentists who perform research after graduation. MODEL 2 suggests that a combination of the perceived importance of research, competition, and perceived expectations from others contributes to a student’s decision to join the Jarvie Society. This result highlights the strategic mindset of students, since many students view performing research and participating in extra-curricular activities as methods for bolstering their candidacy when applying for programs following dental school. MODEL 3 suggests that being knowledgeable about both the people to contact for research and the locations of dental research, can contribute to a student contacting a faculty member for research opportunities. Thus, CDM can take steps to improve its communication to students, focusing on the faculty to contact for research and various locations available for research.

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Prevalence of Probable Obstructive Sleep Apnea at Columbia University Medical Center: Vanderbilt Dental Clinic

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Introduction: Obstructive sleep apnea (OSA) is a disorder characterized by recurrent cessation of or significant decrease in airflow, despite breathing effort during sleep. It has recently surfaced as one of the most common chronic diseases in the United States. Prevalence estimations of OSA show 2% for women and 4% for men. OSA has shown to be correlated with increased risk for congestive heart failure, coronary artery disease, hypertension, myocardial infarction, cardiac arrhythmias, diabetes, and stroke. Excessive sleepiness is a major feature of OSA, leading to increased daytime accident risk and decreased daytime cognitive function. Potential risk factors for OSA include: excess body weight, alterations in upper airway structure, alcohol consumption, smoking, nasal congestion, menopause, pregnancy, and age. Even with such serious comorbidities the disorder still remains largely undiagnosed. Columbia University Vanderbilt Dental Clinic provides dental care to a diverse patient population. This gives us the opportunity to also assess for cultural/ethnic/socioeconomic differences in the risk factors and diagnosis of OSA. Studies suggest both Blacks and Hispanics are at higher risk of OSA and disordered sleep breathing. However, data on this difference is sparse and more needs to be done.

Objective: The purpose of this study is to assess the prevalence of probable Obstructive Sleep Apnea or sleep disordered breathing in a dental clinic population, using the validated, Apnea Risk Evaluation System (ARES) questionnaire and compare the rate to that of the national average. We hypothesize that the prevalence of OSA in our sample is greater than the current national projections.

Materials and Methods: A Cross-sectional study design was used to assess the prevalence and severity of Obstructive Sleep Apnea (OSA) in dental patient at Columbia University College of Dental Medicine Vanderbilt Dental Clinic in the Washington Heights neighborhood of New York City, NY, USA, using the Apnea Risk Evaluation System (ARES™) questionnaire. The ARES questionnaire is a validated, single-page form that can be completed by the patient in less than five minutes without assistance. The questionnaire has been shown to have both high sensitivity and specificity (0.94 and 0.76 respectively). Data obtained from the questionnaire include: age, gender, height, weight, diagnosis of diseases associated with risk for OSA (i.e., high blood pressure, heart disease, diabetes, or stroke) and prior diagnosis of OSA, the Epworth Sleepiness Scale and a 5-scale response to the frequency ratio of snoring, waking up choking, or having been told that the subject stopped breathing during sleep. Subject neck size was not included in our data collection or analysis. The survey responses were analyzed to provide classification of OSA risk. Classifications include: “low risk” (ARES score <5), “high risk” (score >6) and “very high risk” (Score >11). All new patients, 18 and older, upon arrival to Vanderbilt Clinic Patients were asked if they would be willing to participate in our study. 70 subjects volunteered to participate in our study; informed consent was collected from each participant under Columbia University Medical Center IRB standards. All values were self-reported.

Results and Conclusions: ARES questionnaire responses were analyzed and numerical scores were given for each subject. Those scoring 5 and lower were considered “low” risk of OSA, scores 6 or greater were considered “high” risk, and scores 11 and greater were considered “very high” risk. All subjects who had previously been diagnosed with Obstructive Sleep Apnea were correctly classified by the ARES questionnaire to have “high” risk. No subjects were categorized as having “very high” risk. 11 subjects (15.7 percent) were classified as having “high” risk of OSA, of those 3 were female and 8 were male. BMI was plotted against ARES score in Figure 3. No significant correlation was found between BMI and ARES OSA risk was found. The 15.7 percent prevalence we found is higher than the predicted 2-4 percent national data suggests OSA prevalence should be. Of those who were evaluated to have “high” risk for OSA, 81.8 percent were undiagnosed. This data supports our hypothesis that there is a large population of patients who are currently undiagnosed for Obstructive Sleep Apnea that are currently under the care of Columbia University Vanderbilt Dental Clinic. This is of major cause of concern due to all the comorbidities associated with OSA.

Discussion/Future Directions: Though awareness of OSA is increasing, sleep apnea remains largely undiagnosed. Some evidence suggests 82 percent of men and 93 percent of women in the United States remain undiagnosed. Dental professionals are in a unique position, in that they are both able to screen for and treat OSA. Incorporating the ARES questionnaire into practice in order to assess risk of OSA in all incoming patients is something that can be of great value to the patient, in some cases lifesaving. It is for these reasons that recognizing these individuals’ risk of OSA and referring them for confirmation of diagnosis and therapy is of great importance. The future directions of this study include expanding our subject population size, performing overnight sleep studies to confirm OSA diagnosis, and recording neck circumference for all subjects.

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Utilization Patterns of Dental and Medical Services in Dental Patients at Risk for Diabetes

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Introduction: Type 2 diabetes is a serious chronic disease that negatively affects oral health and often remains undiagnosed. A larger study aimed to evaluate screening protocols for undiagnosed diabetes and pre-diabetes in patients presenting at Columbia University College of Dental Medicine (CUCDM) was recently completed. Patients new to CUCDM were initially screened to target a group at-risk for diabetes. Study participants had to be: ≥40 years of age, if non-Hispanic white; ≥30 years of age, if Hispanic or non-white; never have been told that they had diabetes or pre-diabetes; and had to self-report at least one of the following diabetes risk factors: family history of diabetes, hypertension, overweight/obesity, high cholesterol.

Objective: Our objective was to analyze the demographic characteristics and medical and dental utilization patterns of this high-risk patient population in order to obtain a better understanding of their co-utilization of medical and dental health services.

Materials & Methods: Participants were asked to fill out a questionnaire regarding their demographic characteristics (age, race, education), utilization of dental and medical services (frequency of visits, length of time since last visit), health insurance, health-related habits (smoking) and presence of readily reported risk factors for diabetes. Those who fulfilled the entry criteria described above received a chairside HbA1c finger stick test and a periodontal examination. A diagnostic blood test (fasting plasma glucose or hemoglobin A1c) was used to define metabolic status (healthy, pre-diabetes, diabetes). Available test results were reviewed with each patient at the conclusion of the screening process.

Results & Conclusions: A total of 1097 subjects were included in the current analysis. The majority were Hispanic (67.4%), female (64.4%), and had Medicaid as their dental (66.7%) and medical (57.7%) insurance. The most prevalent risk factor was being overweight or obese (78.6%). Based on the diagnostic blood test result, 75.8% of participants were considered to be healthy, while 17.9% were found to be pre-diabetic and 6.3% diabetic. A periodontal examination indicated that 37% of participants had 25% or more of their teeth with at least one periodontal pocket ≥5mm. Study data further indicated that study participants were more active users of medical services than of dental services, with 83.2% visiting their physician for an exam/physical every year, compared to 59.2% visiting their dentist/hygienist that often. When the frequency of visits was combined with time since last visit, in order to create a measure of intensity of medical and dental utilization, 69% of participants had high intensity medical utilization, while 29% had high intensity dental utilization.

Discussion: Preliminary analyses indicate that these dental patients, identified as at risk for undiagnosed diabetes, are frequent users of medical services. Study data further suggest that visits for medical care, although prevalent, may be narrowly focused, limited to the patient’s presenting complaint, and that some underlying systemic risk factors may be overlooked. This interpretation suggests that the dental practice setting can provide an important opportunity to identify individuals unaware of their diabetic status, as well as potentially a number of other systemic diseases. While the majority of study participants were found to be healthy, all of the participants had one or more modifiable risk factors that could be detrimental to their metabolic and cardiovascular health. Informed by the considerable literature on models of health care utilization, further analysis of this data can help us understand the rationale for the pattern of co-utilization of medical and dental health care services followed by these patients.

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The Economic Burden of Oral Cancer in the United States

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Introduction: Head and neck cancers (HNC) cause significant morbidity and mortality in the United States, with an estimated 40,000 new cases in 2012. There have been few published studies of the costs of head and neck cancer in the United States. Among the published body, studies seem heterogeneous in their reporting of cost categories as well as among the follow up period covered.

Objective: To estimate the total treatment costs for an annual cohort of oral cancer patients. Incidence, stage at diagnosis, treatment options per stage, indirect costs, and long term costs for rehabilitation are considered.

Materials and Methods: Bottom-up, incidence-based cost-of-illness analysis using data from Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute (NCI), American Cancer Society’s Cancer Facts and Figures, and all available published research relevant to this topic. To estimate the total cost of HNC in the US we followed the following steps. First we estimated the annual incidence and divided this number into private payers and government payers. We further divided each group by stage at initial diagnosis. We estimated the mean cost of treatment for each of these eight groups during the first four months of treatment. During this period, the patients undergo one or any combination of the following: surgery, radiation therapy, and chemotherapy. Next we estimated the additional costs of healthcare utilization during the five-year follow up period. We estimated indirect costs by calculating loss in wages of patients due to days spent in the hospital.

Results: Based on this method, we estimate the annual cost of HNC in the US to be $2.2 billion. This represents $1.9 billion in direct costs incurred during the initial four months of treatment, $290 million in additional direct costs, and $18 million in indirect costs.

Conclusions: The economic burden of head and neck cancer is substantial. A major driver of the direct cost is stage at diagnosis. By implementing an effective screening program to identify patients at earlier stages, there is potential to significantly reduce the economic burden of HNC in the US.

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The Efficacy of a Web-based Course on Tobacco Cessation for Dental Residents
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Introduction: Tobacco use is the number one cause of preventable disease and death in the United States. Each year, more than 400,000 people die in the U.S. from smoking related causes. Research shows that when clinicians advise their patients to quit they are 30% more likely to be smoke free one year later. As frequent screeners of the population at large, dentists can serve as key players in the cessation process. In addition to the life threatening effects of tobacco use, dentists are able to understand the importance of tobacco’s impact on the oral cavity, and can share this information with patients to help them quit. Tobacco use is associated with periodontal disease, subsequent bone loss, pathology, and deterioration of restorative work. Smoking cessation counseling at every visit and preceding any definitive treatment can help prevent these adverse effects. Despite this, there has been limited adoption of tobacco cessation counseling in practice by dentists. By participating in a self-paced online tobacco cessation course, dental residents can increase their awareness, knowledge, and confidence at the residency stage of training to help increase the implementation of tobacco cessation in practice.

Objective: The objective of this study was to assess the efficacy of an educational website developed for Jacobi Medical Center Dental Residents and Columbia University College of Dental Medicine postdoctoral students on tobacco cessation counseling. We specifically looked at the ability of the multimedia tool to influence the attitudes and behaviors of the residents and to increase their knowledge of the pharmacotherapies and behavioral interventions developed for assisting patients quit successfully.

Materials and Methods: A web-based, self-paced, interactive module on tobacco cessation was developed for the residents. The course consisted of 3 sections: Pre-exam, Post-exam, and Helping Patients Quit. The educational content consisted of a printable course guide, pharmacotherapy table, online texts and videos, brief interactive knowledge and skills assessments, and a virtual patient exercise. We collected pre- and post-survey data that captured demographic information, evaluated if there was an increase in the residents' knowledge and awareness of tobacco use cessation counseling practices, and compared the residents’ self-efficacy in and attitudes toward tobacco use cessation counseling. Subjects were recruited in email and in person, and participation in the study was completely voluntary. All analyses were conducted using SPSS (version 17.0).

Results and Conclusions: There were 59 residents from Columbia University/New York Presbyterian Hospital and 17 from Jacobi Medical Center in our study. At baseline, 62 (81%) of the residents believed that dentists are responsible for Tobacco Cessation counseling. Although residents believed that they should be responsible for tobacco cessation they rated their confidence in conducting these activities as low. Out of a possible score of 35, the mean score for tobacco cessation counseling was 18.5 and the mean for prescribing pharmacotherapeutics was 14.6. Paired sample t-tests showed a statistically significant increase from pre-survey to post-survey in self-efficacy in prescribing (14.58 vs. 21.30), counseling (18.47 vs. 23.4), and total self-efficacy (32.98 vs. 44.67) scores. There were no differences in these scores by gender, race/ethnicity, school, or specialty. Regarding changes in knowledge, there was a statistically significant increase in total knowledge scores from the pre-survey (M=2.017) to the post-survey (M=2.559), p<.05. There was a statistically significant increase in the participants’ assessment of their own knowledge from pre-survey (M=2.85) to post-survey (M=3.19), as well.

Discussion: After completing the course, residents’ knowledge and confidence in their ability to help patients quit tobacco increased. Results of this survey demonstrate that online tobacco cessation education is a feasible option to increase residents’ abilities to provide tobacco cessation counseling in dentistry. The low confidence and behavior scores at baseline also indicate that current residents are lacking key tobacco cessation knowledge, skill and self-efficacy and helping them to build these competencies is beneficial in bringing tobacco cessation into the clinical setting.

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Addressing Health Literacy Challenges to Target an Educational Message for HIV-Positive Dental Patients

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Introduction: Harlem United Community AIDS Center (HU) is a non-profit, community-based healthcare organization located in Harlem, New York City. HU offers its patients access to a full range of social, supportive, medical, and dental services as part of a comprehensive approach to care. The majority of HU patients are infected with, or are at high risk for, HIV/AIDS. Many of these patients face barriers to care due to addiction, mental illness, poverty, race, and sexual or gender identity. The patient population experiences a range of literacy and educational levels, which are often below the health literacy and readability levels of current educational material available to patients.

Objective: We aimed to develop an educational pamphlet on HIV and oral health that better meets the needs of the HU patient population. We sought to evaluate the suitability of existing HIV and oral health educational material, understand the common discrepancy between readability of educational material and patient health literacy level, determine if individual health literacy can be quickly assessed in the HU dental clinical setting, and identify characteristics of educational material with appropriate health literacy and readability levels.

Materials & Methods: Our new oral health pamphlet is informed by three sources: (1) quantitative and qualitative feedback from HU patients gathered through a structured interview and survey, (2) evidence-based recommendations developed from literature reviews on health literacy and readability, and (3) expert advice from oral pathologists and HIV specialists. For the survey, HIV-positive patients at the HU dental clinic were approached, invited to participate, and, if willing, consented to participate in the study. The patient subjects reviewed oral healthcare educational material, and were then interviewed individually regarding their understanding and opinions of the material. The structured interview was based on an instrument developed specifically to elicit both qualitative and quantitative opinions regarding the brochure, as well as an assessment of patients’ educational level. Open-ended responses were evaluated for their thematic content, while closed-ended quantitative attitudinal data were analysed using SPSS v. 17. Literature reviews were conducted on the topics of health literacy, with a focus on oral health literacy and the HIV positive population, and readability. Evidence-based recommendations were then developed to improve the readability of the new pamphlet. Interviews were conducted with oral pathologists, HIV specialists, and HU staff members to identify the current oral health challenges facing the HIV-positive population.

Results & Conclusions: Twenty-two percent of participants surveyed said they sometimes or often have problems learning about medical conditions because of difficulty understanding written materials. For items requiring the participant to evaluate critically the information available in the pamphlet (e.g., “This handout taught me how HIV/AIDS medications can increase the risk for cavities”), participants with a higher education level were more likely to correctly recognize that such information was not available in the pamphlet. Evidence-based recommendations from the literature review included: simplify written material to a fifth grade level, use two syllable words and sentences with eight to ten words, use bright colors, and use sans serif fonts in size 14 or larger. Expert advice included suggestions to focus on oral health in general, rather than specific diseases; and to include only four specific diseases (i.e., candidiasis, aphthous ulcers, oral hairy leukoplakia, and oral warts).

Discussion: The new pamphlet we developed on HIV and oral health was based on the quantitative and qualitative feedback we received from HU patient subjects, HU staff, oral pathologists, and HIV specialists, as well as literature reviews on the topics of oral health literacy and readability. Reducing the size of the pamphlet and titling the pamphlet “Harlem United Oral Health Guide,” in order to remove the word “HIV” from the title, allows the patients greater privacy, as requested, when reading the pamphlet in public. Increasing the font size, using bright colors, and improving the quality of oral photographs addresses prominent criticisms of the older educational material. The new pamphlet, informed by patient and expert feedback as well as evidence-based suggestions, is targeted more specifically to the needs of the HU dental patient population.

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Retrospective Case Study on the Damaging Salivary Gland Effects of Radioactive Iodine Therapy for Thyroid Neoplasm

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Introduction: Thyroidectomy followed by oral administration of therapeutic dose of radioactive iodine is effective in treating thyroid carcinoma. A significant portion of the radioactive iodine is stored and secreted through the salivary glands. Radiation damage to salivary glands occurs in an asymmetric pattern and manifests itself as alterations in saliva composition, obstructive sialadenitis, and/or severe reduction of flow rate. Dexamethasone, a long acting glucocorticoid, has anti-inflammatory and immunosuppressive effects.

Objective: The purpose of the present study was to evaluate the impact of dexamethasone irrigation on alleviation of long-term effects of radiation symptoms.

Hypotheses: 1) Irrigation with Dexamethasone decreases adverse symptoms of pain and swelling caused by radioactive iodine therapy. 2) Patients’ symptoms are dependent upon the dosage of radioactive iodine and the time passed since radiation therapy.

Methods: Randomized follow up study of 50 patients using the following criteria: history of thyroidectomy, iodine radiation therapy, presented to Salivary Gland Center (SGC) at Columbia University College of Dental Medicine over last 20 years, complaint of obstructive symptoms of pain and swelling or dryness, history of glands evaluation by means of the radioisotope technetium Tc 99m pertechnetate (TPT). All the patients were offered 3 treatments with dexamethasone irrigations (each irrigation contains 2cc dexamethasone) by means of blunt needle injection technique into the affected ducts, but some refused the treatment. We were able to reach only 25 patients (n=4, f=21) who were willing to participate in phone study. The phone interview included verbal consent, reviewing of the patient’s chart including salivary gland involvement and TPT result, and current patient status using ordinal scale (better, same, worse). For each patient, radioactive iodine therapy dose (mCi) and the date of the last dose were recorded to account for the effect of these parameters on the results. Statistical analysis was performed using SPSS software for MAC. Data is presented as percentage or numbers. Comparisons between effect of dexamethasone and patient symptoms (result) were made using Chi-square test and is shown in Figure 1. Linear discriminate analysis was used to assess the relationship between radioactive iodine dose, time, and patient symptoms (result) and is shown in Figures 2 and 3.

Result: Using TPT study, 59% of all patients had a history of obstructive symptoms in the parotid glands, 6% had symptoms in the submandibular glands, and 35% had symptoms in both. From the 25 people who met the inclusion criteria, 64% felt better (Dexa=88%, No dexa=12%), 36% felt the same (Dexa=78%, No dexa=22%), and no patient felt worse than first visit to SGC. 84% of patients (study group, n=21) had accepted dexamethasone treatment and 16% of patients (control group, n=4) refused treatment. Patients in the study group were allocated into 3 groups. The first (n=14, 67%) was comprised of patients who were feeling better, the second group (n=7, 33%) was comprised of people who believed their symptoms had not subsided. 50% of people in the control group reported that their symptoms got better and 50% reported no decrease in symptoms. Irrigation and post-radiation symptoms (Fig 1): There was no statistically significant difference in symptoms of patients that received dexamethasone compared to control group (Chi-square value=0.405 and asymp. sig= 0.524). No patient ever reported worsening of the symptoms. However, there was a weak association between irrigation and symptoms (phi-coefficient=-.127 and Cramer’s V= 0.127). 38% patients (n=8) reported immediate relief of symptoms after dexamethasone irrigation. Neither increasing radioactive iodine dose nor shorter time periods after radiations were associated with worsening of the symptoms (canonical correlation= 0.391, chi-square=3.651, P value= 0.161). The radiation dose has a greater impact on resulting symptoms (Function coefficient=0.682).

Discussion: Alterations in salivary gland function following radioactive iodine therapy has been reported. Serous parotid salivary glands are more susceptible to radioactive iodine than the mucous submandibular glands, and, therefore, most side effects are present in the parotid gland. Radiation damage to salivary glands is irreversible since these cells divide rarely, and therefore no drug can cure the adverse effects. Salivary obstruction combined with oral dryness and discomfort developed in all patients in this study. In the present study, dexamethasone was offered to patients that reported adverse effects of radioactive iodine therapy to decrease subjective symptoms. Even though the direct effect of dexamethasone treatment on patient symptoms cannot be observed, the clinical importance of this medication cannot be ignored due to the fact that immediate relief was reported in many patients. Surprisingly, this study provides controversial evidence for direct association between symptoms and either radiation dose or time. There were many barriers to this study, not the least of which was recruitment of adequate patient numbers to provide powered results and inclusion of patients who had received different dexamethasone dose to conduct a dose-dependent study.

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Post-Doctoral Student Abstracts
Alveolar Bone Changes to Orthodontics in an Osteopenic Patient with Possible Hajdu-Cheney Syndrome
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Introduction: Hajdu-Cheney Syndrome (HCS) is a very rare autosomal dominant disorder of bone metabolism characterized by progressive focal bone destruction, including acro-osteolysis of the distal phalanges and progressive osteoporosis. Only approximately 50 cases have been reported to date. The disorder is associated with a Notch2 mutation that is thought to be important in the development and maintenance of the skeleton by modulating RANKL-induced osteoclastogenesis. A 13-year old osteopenic male with skeletal Class III malocclusion and possible HCS presented for orthodontic treatment. The maxillary arch was severely crowded and the incisor angulation was extremely flared. In order to determine the extraction pattern of the patient in the maxillary arch for pre-surgical orthodontics, we needed to determine how the patient would handle orthodontic tooth movement.

Objective: To evaluate the alveolar bone effects of orthodontic tooth movement on an osteopenic patient with possible Hajdu-Cheney Syndrome using a cone-beam computed tomography (CBCT) and compare that to published norms of alveolar bone density and bone levels during orthodontic tooth movement.

Materials and Methods: The first premolars were preferentially prescribed to expand 2.0 mm using clear plastic aligners, Invisalign (Align Technology). Cone-beam computed tomography (CBCT) images were taken prior to expansion (T0) and 3 months following (T1) the completion of expansion. Linear alveolar buccal bone levels were made by measuring for buccal bone thickness (BBT) and buccal marginal bone level (BMBL) at the right and left first premolar. In addition, bone density changes around the buccal aspects of the right and left first premolars at three portions of the root (cervical, intermediate, and apical) were calculated.

Results: Actual expansion achieved immediately following expansion was 0.9 mm. Expansion remaining post-retention was measured at -0.01 mm. Linear CBCT measurements of the BBT from T1 to T2 revealed a gain of 0.25 mm for the right premolar and a loss of 0.20 mm for the left premolar. The BMBL measurements revealed a gain of 0.66 mm and a loss of 0.07 mm for the right and left first premolars respectively. The bone density measurements increased during the study at 6% and 23% for the right and left first premolars respectively.

Discussion: Out data indicates that, while 0.9 mm of expansion was achieved initially, the patient was non-compliant in the retention phase of treatment. When the T2 CBCT was taken, there was a slight constriction of the first premolars of 0.10 mm. In addition, the bone density around each premolar actually increased from T1 to T2, which is the complete opposite of what happened in normal orthodontic tooth movement. Both BBT and BMBL were negligible in comparison to that of someone with normal bone physiology. Using a banded hyrax device would have eliminated the need for compliance during the retention phase of treatment.
Detecting Fracture with Contrast Medium and Periapical Films
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Introduction: Fracture detection is an important part of dental practice. Early detection of tooth fractures is important from clinical, treatment planning, and also economic aspects. Tooth fracture can be difficult to diagnose and hard to visualize in a conventional periapical radiograph due to low contrast between fracture and tooth, direction of fracture, and overlapping of anatomical structures. Few studies have been done to answer the clinical question of what is an effective method of detecting fractures. According to x-ray attenuation equation, S=N0e, the difference in radiopacity between teeth and space of fracture represents the visibility of fracture on radiograph. Two variables, the differential between the X-ray attenuation of the tooth and the fracture space as well as the angulation of x-ray with respect to the line of the fracture determine the contrast, were identified to directly affect the difference in radiographic contrast and thus the visibility of fracture on the radiograph.

Objective: The purpose of this in vitro study was to evaluate potential improvements in fracture detection by increasing attenuation, utilizing aqueous iodine, and by changing angulations.

Methods and Materials: Twenty-one fractures of 25µm were created in extracted teeth. Radiographs of each fractured tooth were taken without and with contrast at 90, 45, 30, and 0 degrees to the fracture line. Five observers were calibrated prior to the study. Data from these five observers were analyzed by McNemar’s Test.

Results: The visibility of fractures on periapical films taken at 90, 45, 30 and 0 degrees were 5%, 33%, 49%, and 98%. Visibilities of fractures using contrast solution were 80%, 99%, 97%, and 100%. At 95% confidence interval, the data showed that utilizing iodine contrast and changing angulations significantly enhanced the fracture detection.

Conclusion: This in vitro study showed (1) fractures can be readily seen on dental films by adding contrast solution into the fracture space and by taking x-rays at 30 to 45 degrees angulations and (2) radiographs without iodine contrast taken at 45, 30, and 0 degrees to the fracture had higher chance of showing fracture compared to those taken at 90 degrees.

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Introduction: Various ceramic abutment systems with different implant-abutment connection designs are available and present different modulus of elasticity and fracture resistance. Zirconia implant abutments exhibit excellent fracture resistance due to transformation toughening. However, some of their limitations are the mechanism of crack propagation and the fact that zirconia is a non-silica based ceramic with controversial cementation protocols. Lithium disilicate glass ceramic provides the option of either conventional cementation or an adhesive bonding protocol. Therefore, this material has the potential to be used for definitive implant restoration and can create a strong bond at the abutment-crown interface.

Objective and Methods: The in-vitro single-load study evaluates the fracture resistance of zirconia and lithium disilicate implant abutments using titanium metallic inserts. Metallic inserts were either retained by clamping or cementing into the ceramic abutments according to the manufacturer’s guidelines.

Discussion: In the literature, use of cementable abutments can provide resistance to rotational forces that may cause screw loosening. Moreover, the luting agent interface between metal surfaces will allow small discrepancies not acceptable in a screw maintained fixture and may even act as a shock absorber. From this research was noted that failure of all zirconia and lithium disilicate systems originates with screw bending at approximately 370-400N. The authors were concerned about the additional mode of failure of cementable abutments (adhesion or cohesive) at the zirconia or lithium disilicate-Ti abutment interface. No cement failures were noted in either group up to 600 N. Preload will be lost from abutment retaining screw prior to fracture of the abutment-crown complex. Improved failure loads may be possible if screws with increased bending resistance are used.

Conclusion: The type of ceramic abutment material and implant connection influences stability and fracture resistance of ceramic abutments. The failure mode of both test and control groups was similar; bending of abutment retaining screw. The cementable zirconia and lithium disilicate abutments had similar fracture resistance, which was higher than other 2-piece zirconia and pressed lithium disilicate abutment systems. All test samples demonstrated adequate strength for use in the anterior region.
Relationship Between Serum Biomarkers of Bone Metabolism and Progression of Periodontal Disease: The Osteoporotic Fractures in Men (MrOS) Study
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Introduction: Periodontitis is an inflammatory disease of tooth-supporting tissue and can be found in about 30% of the adult population in the United States. More recently, this estimate has increased to over 47%, or 64.7 million Americans, with adults over 65 years accounting for the majority of cases. While a causal relationship has not been established, systemic factors likely modify the host response to the primary infectious nature of the disease attributed to bacteria and bacterial lipopolysaccarides (LPS), resulting in specific forms and patterns of periodontal disease. With this, it has been proposed that overall bone metabolism may be associated with progression of periodontal disease, and that biomarkers of bone metabolism could be utilized to predict occurrence and/or progression of this highly prevalent disease.

Objective: The purpose of this study was to: 1) evaluate the relationship between bone metabolism biomarkers with the occurrence of periodontal disease in older men (65+ years of age), and 2) to identify predictors of incident of periodontal disease or progression.

Materials and Methods: Between March 2000 to April 2002, 5994 men were recruited to participate in the Osteoporotic Fractures in Men Study (MrOS), a longitudinal study of the epidemiology of osteoporosis and fractures in older men. Between September 2002 to May 2003, 1353 men participated in a dental exam. Of these participants, 829 returned for a second dental exam between March 2005 and May 2006. Diagnoses/Progression of periodontitis was based on clinical dental measurements, which included clinical attachment loss (CAL), pocket depth (PD), calculus, plaque, and bleeding on a random half-mouth, plus a questionnaire regarding access to care, symptoms, and previous diagnosis. Offenbacher’s biofilm-gingival interface classification system was utilized to define periodontitis categories and disease progression to a more severe disease category. Biochemical parameters included serum levels of calcium, vitamin D, parathyroid, phosphate, alkaline phosphatase, albumin, alpha- carboxy-terminal collagen crosslinks (CTX), beta-CTX, and CTX. Only 141 of the men who came back for a second dental visit had all biochemical markers analyzed and were, therefore, included in the periodontal disease progression analyses. All statistical analyses were performed using SAS version 9.3. SAS Institute, Cary, NC, USA. Cochran-Armitage trend tests for categorical variables and logistic regression models for continuous variables were performed to test if characteristics differed by baseline periodontitis status. Log-binomial regression models with a robust variance estimation were used to assess the relative risk of periodontitis progression according to levels of the baseline biomarkers. Multivariable models were manually constructed to assess and control for confounding factors.

Results and Conclusions: Of the 141 men followed in this study, 61 had periodontal disease that got progressively worse, while 11 actually showed improvement. Trend tests demonstrated statistically significant relationships between higher levels of alpha-CTX (ug/L), beta-CTX (ug/L), and CTX (ng/mL) and progression of periodontitis. For example, individuals who progressed to a more severe category of periodontitis had the highest alpha-CTX values at baseline, while individuals who had their periodontal condition improve over time had the lowest values (5.9 ± 5.5 ug/L vs. 2.9 ± 1.2 ug/L, p < .05). Similarly, for beta-CTX, values were 17.4 ± 14.9 ug/L and 8.9 ± 3.6 ug/L, respectively (p < .05). Baseline CTX values were 0.41 ± 0.14 ng/mL in progressive periodontitis and 0.27 ± 0.11 ng/mL for improved periodontitis (p < .05).

Discussion: This study suggests that biomarkers of bone metabolism may be utilized to help predict which patients are more likely to have their periodontitis progress to a more severe disease level. Serum CTX levels are indicative of osteoclast activity and function, which may correlate to how rapidly bone can be lost during active periodontal infection and inflammation. This information could potentially be utilized to help determine the type of periodontal therapy that should be provided and at what stage of disease treatment should be implemented. Future intervention studies should be performed to evaluate the benefits of utilizing serum CTX levels as a diagnostic indicator of future periodontal disease progression, and benefits of applying therapeutic measures, accordingly.

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Effects of Platelet Derived Growth Factor (PDGF) on Dental Sac Cell Migration and Differentiation
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Introduction: GEM 21S® (Osteohealth) Growth-factor Enhanced Matrix, a dental device with highly purified recombinant human platelet-derived growth factor (rhPDGF-BB) and an osteoconductive matrix (beta tricalcium phosphate, β-TCP), is used by clinicians to regenerate periodontal tissues. Extensive animal and clinical studies have demonstrated that PDGF is a broad acting growth factor with chemotactic effects on osteoblasts, cementoblasts and fibroblasts. These cells are derived from the dental sac which contains stem/progenitor cells that can differentiate into alveolar bone, cementum, and periodontal ligament. In the presented work, we investigated the migratory effects of PDGF on the dental sac stem/progenitor cells.

Objective: The aim of this study is to compare the migratory effect of Emdogain® (Straumann), BMP-4, BMP-7, TGF-β and rhPDGF-BB on rat dental sac cells.

Materials and Methods: Dental sac cells were isolated from 7 day old Sprague Dawley-rats and were propagated in DMEM containing 10% FBS, 1% antibiotics. The cells were further characterized using colony forming assay. Briefly, 50 dental sac cells were seeded in 3 cm diameter dish and cultured for 2 weeks. After fixation, the cells were stained with crystal violet. Colonies larger than 2 mm were counted. The cells were also examined for osteogenic differentiation. Cells with 80% confluence were cultured in osteogenic induction medium (5mM beta-glycerophosphate, 50ng/ml Ascorbic acid, and 10⁻⁶ M dexamethasone). Medium was changed 2 times per week. After 3 weeks, cell differentiation was examined using Alkaline Phosphatase (ALP) staining and von Kossa staining. Cell migration was tested using Boyden Chamber assay. Boyden chamber inserts with 8µm pores were seeded with 1 x 10⁵ dental sac cells and placed in wells containing the following solutions: 1% FBS, 10% FBS, 30% FBS, and Emdogain, BMP-4, BMP-7, TGF-β and PDGF at various concentrations (10, 50, 100 ng/ml). Cells were allowed to migrate for 12 hours, detached from the chamber barriers with 0.25% trypsin, and then counted.

Results and conclusion: 1) The dental sac contains stem/progenitor cells. In vitro, dental sac cells display spindle shape morphology, can form colonies, and can differentiate into osteoblasts as demonstrated by the ALP staining and von Kossa staining. 2) PDGF promotes dental sac cell migration. 10 ng/ml PDGF induced almost 40% dental sac cell migration, while 50ng/ml induced over 80% migration. Both ratios are much higher than the result of 30% FBS group (30% migratory cells), which was used as positive control in this study. Other factors, BMPs, Emdogain and TGF-β, did not show dramatic chemotactic effects.

Discussion: In this study, we compared the chemotactic effect of PDGF to other clinical drug and osteoinductive factors. Among the migratory cues examined in this study, PDGF is the most potent chemotactic factor, which may partially contribute to the therapeutic effect of GEM-21S.

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Evaluation of Fracture Resistance of E-Max Lithium Disilicate Customized Implant Abutments
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Introduction: A recent study conducted by Sailer et al showed that the estimated 5-year survival rate of ceramic abutments on implants was 99.1%. Mechanically, zirconia (ZR) exhibits excellent fracture and chemical resistance as a result of transformation toughening. However, the mechanical shortcomings of ZR include their sensitivity to specific critical applied stress and controversial cementation protocols. The introduction of a lithium disilicate (LD) glass ceramic with 400 MPa of biaxial flexural strength (IPS e.max, Ivoclar Vivadent,) provides dentists with the option to use either conventional cementation or an adhesive bonding protocol. Therefore, this material has the potential to be used for definitive implant restorations. To date, there have been no published studies exploring the use of LD as an option to fabricate implant abutments.

Objectives: The aim of this in-vitro pilot study is to evaluate the feasibility and the fracture resistance of customized LD E-max pressed abutments with E-max anterior monolithic crowns. Abutments incorporating metal inserts have shown to play a beneficial influence on the stability of ZR abutments. This study will evaluate 4 different implant connections (Branemark External hex, Nobel Replace Select, Biomet 3i, Straumann bone level).

Materials and Methods: A total of 20 Abutments were tested. Machined engaging gold cylinders will be used to press the test LD groups. The null hypothesis is that pressed LD abutments will show clinically acceptable fracture resistance when compared to prefabricated ZR control abutments.

Discussion: Failure modes of the ZR abutments were predominantly bending at the implant-abutment connection and screw loosening. The test LD abutments presented fractures at the cervical third level of the gold cylinders, where higher concentration of tensile forces was found. Results didn’t show any debonding of the abutment-crown assembly. The intact abutment-crown interface could be explained by the chemical composition of lithium disilicate and its ability to create a strong bond. Most samples presented circumferentially around the metal insert of the gold cylinders, pressed lithium disilicate ceramics. This explains LD has the capability to flow and bond efficiently to metal.

Results & Conclusions: E-Max abutments were technically possible to fabricate. LD pressed to the gold cylinders formed a strong adhesion. All test samples demonstrated adequate clinical values of strength for anterior use (>300N). Plus, there were no statistical difference between the ZR and respective E-max groups (p>0.05) except for the 3i group (p<0.01). The mean value of fracture resistance of ZR and LD pressed for Rp Select (483.4N) and Branemark ext Hex groups (366.6N) were the highest. The Straumann (387N) and 3i BioMet (447.2N) ZR values were similar to Branemark ext hex (432.8N) and Nobel Replace Select (430N). The Straumann (282.2N) and 3i (212.8N) LD samples exhibited lower fracture resistance values; explained by the conical design at the implant abutment connection and the non-anatomical crown-abutment design for 3i used for this research respectively.

Supported by The Greater New York Academy of Prosthodontics Grant and Ivoclar Vivadent Inc.
Introduction: All ceramic restorations are gaining market share due to their favorable properties over metal ceramic restorations. Advantages of all ceramic restorations are their excellent biocompatibility and esthetic properties such as high translucency and absence of a metal margin. Zirconia and lithium disilicate restorations clinical acceptance has increased due to their high strength and improved clinical success which is comparable to metal ceramic restorations. However, one of the most common complications for Zirconia restorations is fracture of the veneering porcelain. Fractures of porcelain can either be cohesive within the veneering porcelain or adhesive between the veneering porcelain and core material. Ceramic pressing techniques have been developed as an alternative to layering ceramic on metal and zirconium cores. Varying methods for veneering restorations can result in different ceramic strength.

Objective: The purpose of this study is to compare the shear bond strength of zirconia with CAD/CAM milled lithium disilicate veneering ceramic using a sintering technique to zirconia pressed with fluorapatite glass ceramic using press-on technique and conventional fluorapatite glass ceramic layering technique.

Materials and Methods: 60 zirconia plates were divided into three groups, 1) conventional layered, 2) pressed and 3) CAD-on. The veneering porcelain or lithium disilicate was fired according to manufacturer’s recommendation. 20 samples of POM (pressed on metal) using base metal was used as a control group. Samples were placed into a mounting jig and shear bond strength was evaluated using a Universal Instron machine.

Results: The mean shear strength was 28.9MPa-POM group, 19.1MPa-layered group, 20.1MPa - pressed group, and 60.5MPa- CAD-on group. The CAD-on group showed statistically significant difference among other groups (P<0.001). Only POM and CAD-on group met ISO 9693 Bond test, which requires a minimum of 25MPa.

Conclusion: This study evaluated the shear bond strength of different veneering ceramics and bonding technique to Zirconia cores. The result showed that the CAD-on group, bonding CAD/CAM milled lithium disilicate to zirconia core using a sintering technique, demonstrated the highest shear bond strength and the value provided a statistically significant difference (P<0.001) among other groups.

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One Abutment – One Time, Histologic Analysis
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Introduction: Patients nowadays are more demanding for better esthetic results after implant placement, especially at the anterior region. It has been demonstrated that the abutment connection/disconnection plays an important role in the outcome of crestal bone and soft tissue level. The purpose of this study was to evaluate soft and hard tissue reactions that may occur after different times of screwing and unscrewing healing abutments on implants.

Material and Methods: This is a randomized split mouth prospective longitudinal study. Three teeth were extracted on both sides of the mouth from 12 beagle dogs. Six implants (3.5x8mm, ankylos, densply) were placed 8 weeks following extraction and healing abutments were affixed immediately. In test group 1, the abutments were disconnected/reconnected one time at week 9 following implant placements. The abutments in test group 2 were disconnected three times (once each at week 5, 7 and 9 following implant placements). The control groups remained untouched. Eighteen weeks following extraction, dogs were euthanized and the mandibles were sectioned. Histometric and morphometric analyses were performed and measurements were calculated.

Results/ Conclusion: Healing was uneventful following teeth extraction and implant placements. Results are pending as the histomorphometric analysis is ongoing.
Incidence of Interproximal Open Contact Related to Implant Placement
Posterily and Anteriorly
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Introduction: The loss of Interproximal Contact between fixed implant prostheses and adjacent teeth has recently been reported. This is significant since patients often complain of food impaction. Chronic food impaction may lead to periodontal defects and recurrent decay. In order to prevent implant-tooth periodontal sequelae and tooth decay, a new proximal contact may have to be established between the prosthesis and adjacent tooth. Due to a lack of sufficient research on this topic, it is important to determine the incidence of Interproximal Contact Loss (ICL) and identify causative contributing factors. Upon completing the research, clinical guidelines may be established to prevent Interproximal Contact Loss and proper informed consent.

Objective: The aim of this study is to determine the incidence of open contacts between single implant prostheses and adjacent teeth.

Materials and Methods: Patients between the ages of 19 and 91, both male and female were included in this pilot study. The period of evaluation after implant restoration insertion was between 3 months and 11 years. The participants were seen at random intervals in order to identify Interproximal Contact Loss. The interproximal contacts were evaluated by using dental floss. Contact was considered open if floss passed without resistance from adjacent teeth. ICL was also confirmed visually.

Results: Overall ICL was 48%. 77% were on the mesial surfaces and 23% on the distal. ICL was noted 44% in the maxilla and 56% in the mandible. The posterior region was affected 89% versus 11% in the anterior region. Among the incidents of ICL a significant percentage of 47%, presented food impaction and almost 42% of the patients were aware of the ICL.

Discussion: The ICL rate was 48%. The mesial drifting caused by the interproximal wear of natural teeth, mesial migration, occlusion and parafunctional habits are possible causative factors of ICL.

Conclusions: 48% of implant restorations demonstrated ICL. This results dictates that ICL should be included as an implant complication. The high incidence of ICL is justification for proper informed consent. The high incidence of ICL and associated clinical problems need to be addressed. Further research is necessary to identify causative factors for ICL. The authors suggest the use of an Essex retainer in order to prevent the IC loss between the implant restoration and adjacent tooth. Evaluation of IC between the implant restoration and adjacent tooth should be periodically monitored.
Effect Of A Glutaraldehyde-Based Dentin Desensitizing Agent on the Retentive Strength of a Bioceramic Luting Cement

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Introduction: Dentinal desensitizing agents are frequently utilized after tooth preparation to prevent post-preparation sensitivity and prior to cementation to prevent post-cementation sensitivity. Nanostructurally Integrating Bioceramic (NIB) luting cement has been introduced recently. This dental material distinguishes itself from existing primary classes, such as resins and glass ionomers, and also from water-based cements, such as zinc phosphate cement. Minimal information has been published evaluating the retentive strength and solubility of this new class of luting cement.

Objective: To evaluate the effect of a glutaraldehyde-based dentin desensitizing agent on the retentive strength of this new class of luting cement compared to the other two self-etching resin cements.

Materials & Methods: 72 freshly extracted molars were embedded in a stainless steel mounting ring with autopolymerizing acrylic resin. The occlusal surface of each mounted tooth was prepared flat 4 mm above the CEJ. A high speed handpiece secured in a milling apparatus on a dental surveyor with a diamond bur was oriented at an angle of 10° from a vertical axis to create a total convergence angle of 20°. The teeth were impressed with polyether and dies fabricated with type IV dental stone. Full crown wax patterns were made. The crowns were cast in Type III gold alloy. Metal/Zirconia Primer was applied in the internal surface of the castings, except for the Ceramir group. The teeth were divided into three groups. Each group was subdivided into 2 groups of 12 teeth. One group of 12 acted as the control for each cement. The other group received a gluteraldehyde desensitizing agent (Systemp® desensitizer, Ivoclar Vivadent). Group I – single-step self-etching resin cement: RelyX Unicem, Group II – two-step self-etching resin cement: Multilink Automix and Group III – bioceramic luting cement: Ceramir. Specimens were stored in water for 24 hours and thermo-cycled between 5°C and 55°C for 2500 cycles with a 30-second dwell time. The crowns were subjected to an axial dislodgment force until failure using a universal testing machine at a cross head speed of 1 mm/minute. Failure was defined as dislodgement of the crown from the tooth preparation or fracture of the clinical crown or root. The force at dislodgment was recorded.

Result: With the use of a glutaraldehyde desensitizing agent, RelyX Unicem (37%) and Multilink Automix (24%) demonstrated decrease in bond strength. Ceramir demonstrated 27% increase in bond strength. Retentive results of the cements without desensitizing agents demonstrated bond strengths of RelyX Unicem (913 N) > Multilink Automix (723 N) > Ceramir (470 N).

Conclusion: The use of a glutaraldehyde desensitizing agent decreased the retentive strength of self-etching resin cements. RelyX Unicem exhibited higher failure loads than the 2-step Multilink Automix system.
Circulating Endothelial Progenitor Cells in Periodontitis

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Introduction: Circulating Endothelial Progenitor Cells (cEPCs) are bone marrow-derived stem cells that are recruited into the blood stream and can home to sites of endothelial injury where they can develop into functional endothelial cells. cEPCs have attracted attention as markers for endothelial function and due to their potential use in therapeutic angiogenesis, but also because of their association with a number of pathologic conditions, including sepsis, atherosclerosis, rheumatoid arthritis and inflammatory bowel disease. From a biological plausibility point of view, there are two distinct alternatives through which periodontal infections may be related to cEPC levels: The transient bacteremias and the state of systemic inflammation and endothelial damage that are associated with periodontitis may induce enhanced EPC recruitment from the bone marrow, resulting in an increase in the levels of cEPCs in the bloodstream. On the other hand, vascular endothelial damage may result in cEPC homing to sites of endothelial injury, and systemic inflammation may impair cEPC proliferation and increase cEPC apoptosis resulting in an exhaustion of the cEPC pool and lower cEPC levels.

Objective: The aim of this cross-sectional study was to compare the levels of endothelial progenitor cells in the peripheral blood of patients with moderate to severe periodontitis to that of age-, gender- and menstruation cycle-matched periodontally healthy controls.

Materials and Methods: A total of 110 participants, men and women between 25-65 years of age with >20 teeth present, have been enrolled to date. These included periodontitis patients (> 2 teeth per quadrant with a probing depth of ≥ 5 mm and clinical attachment loss of ≥3 mm as well as bleeding on probing at ≥30% of their sites) and periodontally healthy controls (no teeth with probing depth of >5 mm or interproximal attachment loss > 2mm). Individuals using antibiotics within 3 months of recruitment, those diagnosed with systemic conditions known to affect periodontitis or EPC levels (i.e., hypertension, hypercholesterolemia, rheumatoid arthritis), pregnant women and current smokers were excluded.

All participants underwent a comprehensive evaluation of their periodontal status including assessments of plaque, bleeding on probing, probing depth (PD) and clinical attachment loss (CAL). Body mass index (BMI) and systolic blood pressure (SBP) were recorded, and a 60 ml blood sample was obtained. Hemangioblastic cEPC levels were assessed as a percentage of viable peripheral blood mononuclear cells using flow cytometry, based on the expression of progenitor cell markers CD34 and CD133 and of endothelial cell marker KDR (kinase insert domain receptor). Monocytic cEPC levels were assessed after culture of peripheral blood mononuclear cells and subsequent characterization using fluorescent microscopy on the basis of LDL uptake and lectin staining.

Results and Conclusions: Thus far, hemangioblastic cEPC levels have been assessed in 88 subjects (46 periodontitis patients and 42 periodontally healthy controls) and monocytic cEPC levels in 45 subjects (22 periodontitis patients and 23 controls). Analyses based on 42 matched pairs showed higher hemangioblastic cEPC levels in periodontitis patients than controls (p=0.057) but comparable monocytic cEPC levels (p=0.443). Regression analyses adjusting for age, gender, BMI and SBP showed that the % of pockets with probing depth ≥ 4 mm (p=0.046) or ≥ 6 mm (p=0.008) and the % of sites with attachment loss ≥ 6 mm (p=0.019) were associated with hemangioblastic cEPC levels. Levels of hemangioblastic and monocytic cEPCs were positively correlated (r=0.392, p=0.008).

Discussion: Poor periodontal status appears to be positively associated with cEPC levels, indicating an increased mobilization of EPCs from the bone marrow in response to endothelial injury in periodontitis. The kinetics of this mobilization and its association with vascular repair and function need to be elucidated further.
Assessing Dental Students’ Attitudes, Knowledge, and Intentions toward Treating Young Children
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Introduction: There is an increasing caries rate in young children in the U.S., with many children having untreated decay, and with a disproportionate number of these living in poverty. Seemingly there is a need for an increased number of general dentists to be more comfortable and willing to treat young children and those on Medicaid. Most dental schools do not provide a hands-on training experience aimed at fostering an improvement in this area.

Objective: The purpose of this study was (1) to assess dental students’ knowledge, confidence, attitudes, and intention (KCAI) to treat young children and Medicaid patients, and (2) to evaluate change in KCAI after participation in an intervention including a hands-on training experience.

Materials & Methods: A 27-item questionnaire was administered to Columbia University third- and fourth-year dental students (D3, D4, respectively), that collected information on demographics, knowledge, confidence, attitudes, and intentions to treat infants and toddlers (defined as 0-36 months old) and those on Medicaid. Knowledge questions pertained to infant oral health including caries, diet, hygiene, and treatment. Following this survey, a portion of the D3 and D4 students voluntarily participated in a 1-hour infant oral health seminar and 3-hour clinical experience providing dental examinations to young children and engaging with parents at a Head Start. These students completed the same survey one month later to assess for changes in KCAI. Students were excluded if they had previously participated in the intervention. Comparisons between pre- and post-test results were analyzed using Wilcoxon rank-sum and t-tests.

Results & Conclusions: Of 153 eligible students, 127 completed the initial questionnaire and 34 completed the post-test questionnaire after participating in the intervention. In the initial survey, 37% of students reported their infant oral health knowledge as “good or very good;” while 20% felt confident to perform a dental examination on an infant or toddler. Although 94% felt it was important for general dentists to be able to treat young children, 33% planned to provide preventive care to young children “often or very often,” and 24% if the children had Medicaid. Hands-on clinical program participants felt that “inadequate training as a barrier to treating young children” was significantly less likely after completing the intervention (p=.037). In addition they felt more confident (p<.001) to treat infants and toddlers: position for a dental examination, perform an examination, perform an examination even if crying; and to identify white spot lesions (p=.042). Participants also scored more highly, overall, on a summary measure of knowledge (p=.002) in the post-test survey, and in particular on three questions: recommended position for an infant examination (p=.023), recommended fluoridated toothpaste amount (p<.001), and maximum recommended daily juice intake (p=.009).

Discussion: Study results suggest that one hands-on clinical experience can assist in improving student confidence level and improving their knowledge base to treat these patients. However, measures of participants’ attitudes related to providing dental care to young child and those on Medicaid, as well as their intention to treat these populations, overall, remained unchanged. Past studies have evaluated the impact of more time-intensive infant oral health education programs. Further investigation of multiple-session clinical hands-on experiences is warranted.

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Effect of Pulsed, Percussive Micro-oscillations on Children Receiving Local Anesthesia

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Introduction: Dental injections can be one of the most fear-inducing events experienced during the dental visit for pediatric patients. The minimization of discomfort is especially important as the experience of discomfort can negatively affect the pediatric patients’ behavior making it difficult to complete the dental procedures planned. The "gate-control" theory of pain states that stimulation of large diameter fibers conducting temperature, pressure or vibration can close the neural gate so that sensation of pain or itch are not perceived by the brain. New products have been developed which utilize this theory including the DentalVibe (PPM). The DentalVibe is a cordless, hand-held device that delivers pulsed, percussive micro-oscillations to the site where an injection is being administered. These vibrations are able to reach the brain before the pain sensation and effectively close the neural gate that conducts pain.

Objective: The purpose of this prospective study is to compare the efficacy of PPM to benzocaine during the administration of local anesthesia in children.

Materials & Methods: This study consisted of a sample size of 21 children who required bilateral restorations in their maxillary teeth. Subjects were well-children between the ages of 7 and 12 years whose behavior was stable. A split-mouth design was implemented with benzocaine plus PPM applied to one side and 20 percent benzocaine gel applied to the other. After administration of local anesthesia, patients completed the Wong-Baker Faces Pain Scale (WBFPS) to rate the level of discomfort.

Results & Conclusions: Eleven subjects (52%) were male and 10 subjects (48%) were female; 9 (43%) were younger than 9 years old and 12 (57%) were at least 9 years old. The overall difference in mean WBFPS ratings was not statistically significant (P=.725). Regarding gender, there was no statistically significant difference in males (P=.37) or females (P=.459). There also was no difference in mean WBFPS ratings when looking at age groups younger than 9 years old (P=.826) or in patients 9 years old and above (P=1.0). Using PPM during the administration of local anesthesia did not reduce discomfort when compared to benzocaine alone in this study. Mean WBFPS ratings indicate patients reported increased discomfort with placement of the device.

Discussion: This study had a small sample size. This limitation, however, was offset by the split-mouth design where each patient served as his or her control. We did not find any reduction in discomfort with the use of PPM compared to benzocaine alone. Alternating benzocaine alone and benzocaine with PPM, helped to reduce the influence of pain expectation. Further, the time interval between the first experience and the second experience may have introduced bias. The WBFPS was obtained after administering the local anesthetic in order to obtain information on their initial experience rather than their familiarity with the procedure. Mean WBFPS ratings indicate patients reported increased discomfort with placement of PPM. The majority commented that the vibrations from PPM were “uncomfortable” and this may have influenced their WBFPS rating. PPM is designed to minimize discomfort during the administration of local anesthesia and has been shown to be effective in the adult population. However, PPM was shown to be less effective in this study. Further, studies have shown that pain perception is an individual phenomenon. Culture, personality, and previous experiences are just some of the variables that can affect the psychological perception of pain.

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The Effectiveness of an Interactive Oral Health Promotion Video in a Pediatric Clinic Waiting Room

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Introduction: Patient waiting rooms can be an effective setting for delivering health information. Several studies performed in emergency department waiting rooms have shown improvements in knowledge after watching a health education video. Despite a wealth of education materials, there is little research on the efficacy of audio-visual materials in educating parents on pediatric oral health (“POH”). Several studies have questioned the value of POH handouts and videos versus motivational interviewing (“MI”). Harrison et al. (2007) showed a 46% lower rate in dmfs after 2 years in a MI group versus a group of parents who were given a POH pamphlet and video.

Objective: To determine if a bilingual interactive oral health promotion video (“IOHPV”) will significantly improve parents’ knowledge and attitudes regarding POH.

Materials & Methods: Over 4 months, an IOHPV and control (Disney video) was shown on alternating months in the pediatric medical clinic waiting room at NY Presbyterian Hospital’s Audobon Primary Care Practice. During this time, parents of pediatric patients presenting for medical care completed a questionnaire, which included questions on demographics, knowledge (total of 10 questions on age 1 visit, fluoride, toothbrushing, nutrition, and caries management) and attitudes about POH. Data was analyzed using a commercial software package (PASW).

Results & Conclusions: 155 subjects (57%) and 115 controls (43%) participated in the study (N = 270). 70% (N = 188) of subjects were Hispanic and 57% (N = 154) mainly spoke Spanish. 46% (N = 123) of parents reported their child saw the dentist within the last year. Overall, parents correctly answered 57% of POH knowledge questions. No significant differences in mean knowledge or attitude scores were found between subjects watching the IOHPV and the control, nor was there a difference by race of parent or age of patient. However, there was a significant difference in total knowledge score by report of dental visit with parents who took their child to see a dentist within the last year scoring significantly higher compared to those who did not.

Discussion: The IOHPV was specifically designed to engage parents that presented to the pediatric medical clinic in the Washington Heights neighborhood of Manhattan. However, results show that parents who saw the control video had higher knowledge scores than those who saw the IOHPV. One consideration was the operational design of the waiting room which may have impeded parents from watching and hearing the IOHPV. The waiting room was large, busy and loud. Parents may have been occupied with their child(ren) and not all chairs were facing one of the two televisions. An encouraging finding was that parents who took their child to the dentist in the last year scored significantly higher than parents who did not. Engaging with a dental professional may continue to play a vital role in improving parental POH knowledge.

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Caries Risk Assessment Utilization by Pediatric and General Dentists
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Introduction: Caries management by risk assessment (CAMBRA) represents an approach to preventing and treating dental caries. The risk assessment and the emphasis on the whole disease process, not just the cavitated stage of lesion progression, differentiates CAMBRA from the traditional restorative approach in treating dental caries. Furthermore, CAMBRA attempts to change caries management from the current and predominant one-size-fits-all approach to an individualized risk-based care. While the evidence indicates management of caries by risk assessment is an effective approach to prevent and treat caries, there is concern that risk assessment has been under-utilized in the clinical setting.

Objective: This study explores whether pediatric and general dentists utilize two services in caries assessment by risk assessment: collection of microorganisms for culture and sensitivity (D0415) and caries susceptibility tests (D0425). Specifically, the aim of this paper is to assess the percentage of general and pediatric dentists who perform D0415 and D0425 on the pediatric population, the likelihood of submitting claims for same, and whether the likelihood of performing D0415 and D0425 would increase if dentists received insurance reimbursement for these services.

Materials & Methods: Delta Dental insurance company (hereinafter “Dental Dental”) provided data on dental claims for two services: collection of microorganisms for culture and sensitivity (D0415) and caries susceptibility tests (D0425) submitted between 2008-2011 by general and pediatric dentists for patients under 6 years of age in the five states where they conduct the most business (CA, NY, TX, PA & FL). In addition to the data provided by Delta Dental, general and pediatric dentists were surveyed. A random sample of 500 general dentists from Manhattan and 120 pediatric dentists from New York State were selected. All participants were given a questionnaire regarding the likelihood of performing D0415 & D0425 for a hypothetical patient. Pediatric dentists were additionally surveyed regarding whether the likelihood of performing D0415 & D0425 would increase if they received insurance reimbursement for these services.

Results & Conclusions: When surveyed, the majority of general and pediatric dentists (89% and 88%, respectively) do not take a collection of microorganism for culture and sensitivity (D0415). Further, 67% of general dentists and 38% pediatric dentists responded that they do not conduct a caries susceptibility test (D0425). Of the pediatric dentists surveyed who responded that they do perform D0415 and D0425, the majority of these dentists do not submit a claim to an insurance company (86% of those performing D0415 and 78% of those performing D0425 do not submit claims). The survey responses are in conformity with the data obtained from Delta Dental, which reveals that more than 99% of general and pediatric dentists do not submit insurance claims for D0415 and D0425. However, when pediatric dentists were surveyed, 67% said they would be more likely to perform D0425 and 59% would be more likely to perform D0415 if they received insurance reimbursement for those services. The majority of respondents agreed that a reasonable fee for D0415 for culture and sensitivity is ≥$40 and a reasonable fee for D0425 is $30.

Discussion: Survey of general and pediatric dentists suggests that there is under-utilization of caries risk assessment services. This, to a degree, reflects a lack of monetary incentive as there is both time and cost associated with utilizing these unreimbursed risk assessment tools. However, this does not diminish the evidence showing that S. mutans cultures and caries susceptibility testing are promising approaches for identifying children who need early and intensive intervention to prevent or minimize caries experience.

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ECC Risk Associated with Dietary Changes in WA Immigrant Families in the Bronx
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Introduction: Early childhood caries (ECC) is diet-dependent, highly prevalent, and unevenly distributed with low income, minority, and immigrant children most affected. Caries activity is environmentally determined by factors including behavioral, dietary, educational, and socioeconomic characteristics. These factors, which are also affected by culture and acculturation, are of interest to this investigation. We hypothesize, based on relevant socio-behavioral theory, that acculturation-related dietary changes made by West African (WA) parents will impact the dental health of their children.

Objective: To develop a theory-based survey to determine whether diet related acculturation impacts risk for ECC in a population of WA immigrant families in The Bronx, New York City. The survey will determine: (1) whether acculturation related dietary changes have resulted in increased dietary caries risk in preschoolers in this community; and (2) WA immigrant parents' knowledge about infant and child oral health recommendations in the US.

Materials & Methods: The study involves first-generation English-speaking WA immigrant parents of preschoolers who present to a WA church. Survey questions were developed to test a series of hypotheses about the potential effect of acculturation on dietary and feeding practices and were informed by the immigration and cariology literature and by experts in cariogenic diets. 44 WA parents participated in the study. The survey consisted of 28 questions regarding parental diet pre- and post-immigration, their children’s diet, their knowledge about children's oral health, and their social and built environments.

Results & Conclusion: According to this pilot study, dietary related acculturation is least likely to occur when the WA parent is 22 years or older before immigrating to the United States. In addition, the older the parent prior to immigrating, the more the parent is likely to begin brushing their child’s teeth at 6 months-1year of age.

Discussion: Studies have shown increased risk for caries in children of different immigrant populations, for example, Hispanics, due to dietary related acculturation. In this study we hypothesize that dietary changes in WA parents will impact dental health of their children. Although our findings are not statistically significant, there appears to be a trend that dietary changes does occur in this populace towards a more cariogenic diet. A larger sample size may be needed to detect significance.

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Enhancing Diagnostic Reasoning Abilities of Pre-Doctoral Dental Students with Introduction of Prosthodontics Education and Computer-Based Cognitive Tutor**

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Introduction: Clinical diagnostic reasoning is the core competency of all healthcare professional, which involves cognition and interaction with the environment to understand clinical situations, make diagnostic and therapeutic decisions, and address clinical problems. In this study, we propose that diagnostic reasoning training in pre-doctoral education can be enhanced with proper introduction of prosthodontics education and use of cognitive tutor. As defined by ADA, the essence of prosthodontics education is the development of diagnostic reasoning ability, commonly referred to as ‘Treatment Planning’. Cognitive tutor is a computer learning module based on cognitive psychology theory, particularly the ACT-R (Adaptive Control of Thought-Rational) theory. In this study, prosthodontics education and cognitive tutor technology are combined with various pedagogical theories, such as problem-based-learning, cognitive load theory, teacher-proofing, and more, to formulate an effective learning computer module that enhance pre-doctoral students’ diagnostic reasoning abilities.

Objective: The purpose of the study is to develop and analyze the efficacy of a cognitive tutor that enhance pre-doctoral students’ diagnostic reasoning abilities, combining prosthodontics education and appropriate pedagogical theories.

Materials & Methods: Randomized controlled mixed-method experimental study. Total N=40 (3rd year dental students). Control group (N=20) uses traditional textbook and national board preparation materials on paper. Experimental group (N=20) used novel CTAT-based posthdontics education computer module (10 lessons). Both groups were given 3 days to study with materials provided. Pre-test and post-test were given and analyzed for quantitative analysis. 12-items qualitative questionnaire on 5-point Likert scale were given for qualitative analysis.

Results: The P-value for the control group was 7.67 x E-09, therefore, improvement was statistically significant for the control group. The P-value for the experimental group was 4.42 x E-10, therefore, improvement was statistically significant for the experimental group. When we compared the score increase between the control and experimental groups, the analysis showed that a 2-tailed P-value is 0.015. It is concluded with 95% confidence interval that the experimental group performed significantly better than the control group. Qualitative analysis results show that students were positive toward cognitive tutor in terms of ease-of-use, contents integration, boosting confidence, and enhancing diagnostic reasoning.

Discussion: While the results were favorable toward the initial premise of the study, there are several limitations to the study design: 1) The cognitive tutor was authored mainly with qualitative analysis results from medical education literatures. Since dental experts’ clinical reasoning process may differ from medical experts’, a new qualitative coding analysis must be performed. 2) Quantitative analysis of the study only shows the efficacy of the learning module, not the modality of reasoning process. We must conduct a qualitative coding analysis concurrently with the experiment on same experimental group before and after an intervention to truly claim the change in cognitive reasoning.

**This is a pilot study for a longitudinal in-depth study addressing all of the above limitations, including cognitive coding, that is a part of Dr. Oh’s PhD dissertation thesis.
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