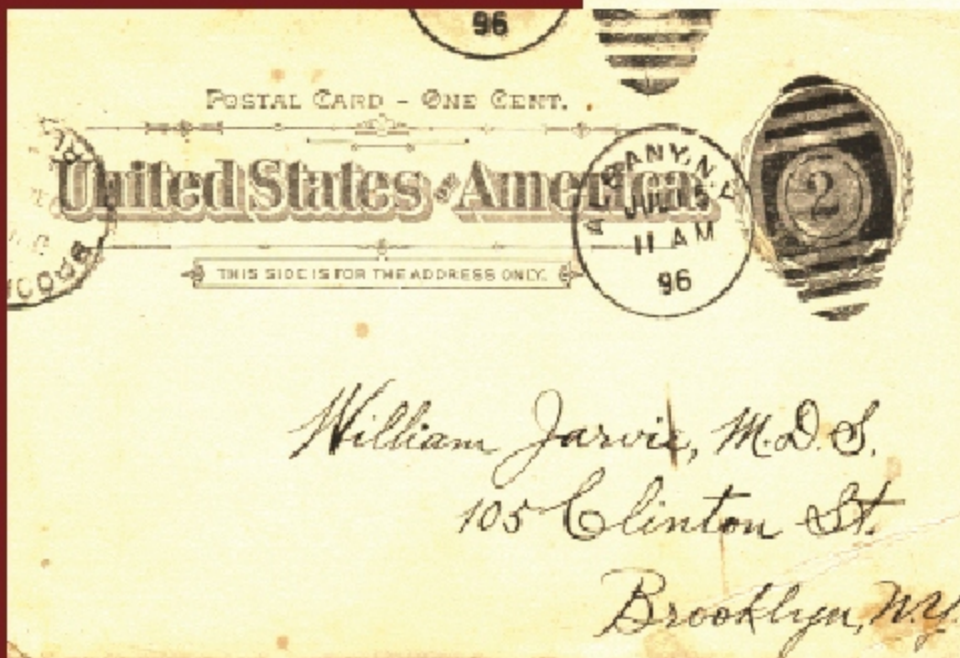
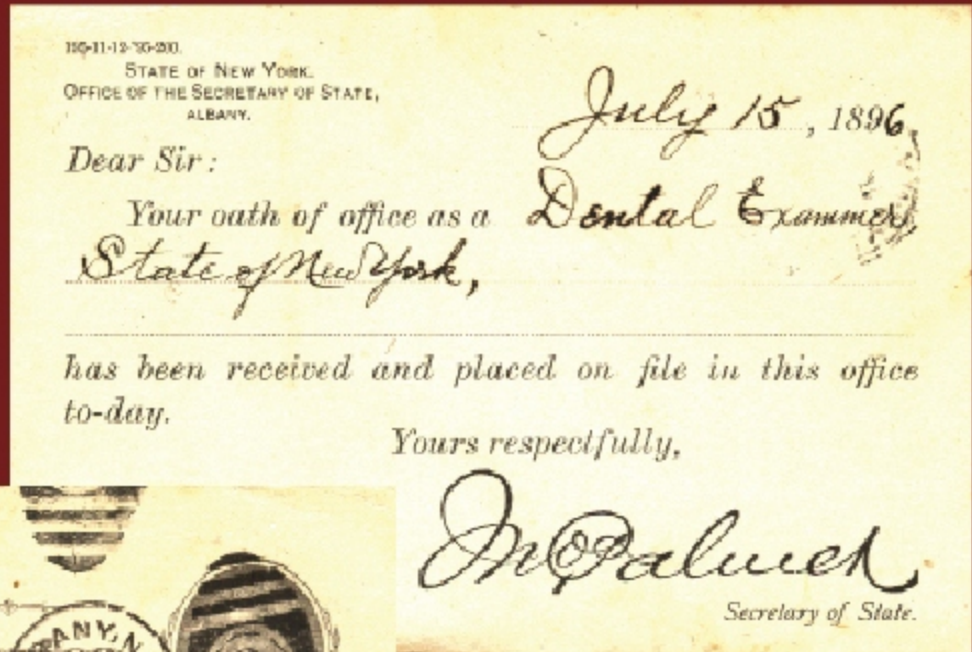




Jarvie

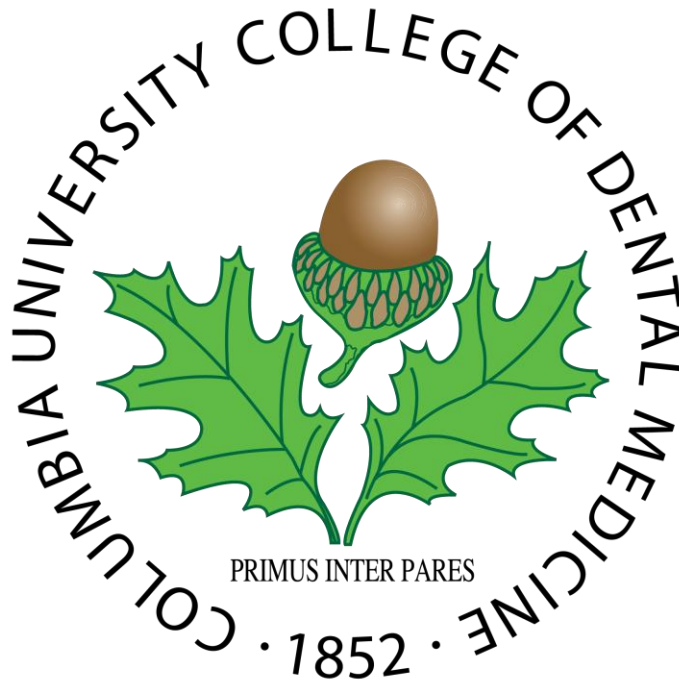
Journal of the William Jarvie Society

Volume 52, Spring 2009



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Columbia University





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City of New York
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**Birnberg Research Program
March 25-26, 2009**

Editor-in-Chief
Deborah Weng '09

Associate Editors

Junhyck Kim '10 Min H. Kim '10 Mariel Nortick '10

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

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

William Jarvie, 1905

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A Message from the Editor

The 52nd edition of the Journal of the William Jarvie Society reflects the increasing interest and research efforts placed in the future of our profession. Ten years ago, the 1999 edition of the Jarvie Journal published twenty-two abstracts. I am proud to say that in a decade's time, we have nearly doubled the number of student research abstracts, in part due to the firm support of our faculty and research mentors and in part due to the growing student participation in research here at the College of Dental Medicine.

The research presented in this year's Journal covers a broad range of fields and also highlights the changing focus of dental research. I thank all the student researchers and faculty mentors for their hard work and congratulate them on their findings.

I would like to extend a warm thank-you to our advisors Dr. Richard Abbott and Dr. Jeremy Mao for their guidance of the Jarvie Society throughout the academic year. Many thanks also to Dean Lamster and Dean Moss-Salentijn for the administration's support of student research.

Thank you to the Jarvie executive board for the cooperative effort that led the Jarvie Society this year, and I especially thank Dr. Abbott, Zi Wang, Jeff Nichelini, and my associate editors Junhyck Kim, Min Kim, and Mariel Nortick for their input and help with the Journal.

Last but not least, I would like to thank the members of the Jarvie Society. There are a growing number of students who are truly interested in dental research, and we are very fortunate to be at Columbia during a time of such academic growth and intellectual curiosity. I strongly encourage all of you to continue your research pursuits after our time here.

Thank you and congratulations again to all of our contributors.

Deborah Weng
Class of 2009



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College of Dental Medicine New York, NY 10032
212.305.4511 Tel
212.305.7134 Fax

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March 6, 2009

Members of the Jarvie Society:

The College of Dental Medicine (CDM) has a tripartite mission including patient care, education and research. The research program at CDM is developing with an emphasis on dental and craniofacial research in the context of health sciences research, and we encourage our trainees to become involved in research.

The Birnberg Research Program, when we highlight dental student research at the College of Dental Medicine (CDM), is one of the most important events on the academic calendar. The abstracts of the presentations are published in the Jarvie Journal, and this year marks the 52nd edition in the series.

Dental student research at CDM has a long history, and research is an important part of the predoctoral program. A research experience as a dental student can have a profound effect on your professional life. Research makes you a better professional because it changes how you think about problem-solving and emphasizes careful evaluation of the literature. These are skills that will serve you throughout your career.

Learned professions are characterized by constant expansion of the knowledge base. Therefore, each of you has contributed to the growth of our profession, and we congratulate you on your efforts.

Sincerely,

Ira B. Lamster, DDS, MMSc
Dean

Columbia University Medical Center



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March 10, 2009

Dear Members of the Jarvie Society,

The Jarvie Society continues a proud tradition of the Columbia University College of Dental Medicine. Research is essential for the survival and growth of the profession and the participation of our students in this important activity holds a promise for the future. Over the years the Jarvie Society has grown and the research reports that are published in the annual Journal have become more numerous and of ever better quality. It is a mark of the commitment and the hard work of all students who have been involved in the research projects and who have prepared these abstracts.

We should reflect also on the important contributions of the research mentors, whose efforts are represented in these reports. Mentors not only host students in their research groups, they guide the experiments, supervise the analyses of the data, and the preparation of the reports. Most importantly, a mentor may be able to ignite that special spark in a student, and what started as a student research project may well become a life-altering experience.

I had the good fortune of finding some wonderful mentors both as a student and early in my career as a young faculty member. I sincerely hope that some of you will have that experience as well. I look forward to reading, seeing and hearing the results of your exciting work!

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

Columbia University Medical Center

History of the William Jarvie Society*

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

After general discussion, it was unanimously voted to proceed with the proposed organization and Joseph Schroff, MD** was elected temporary chairman. Because of the important relation which Dr. William Jarvie bore to the establishment of the School of Dentistry, and because of high interest in the promotion of dental research, it was unanimously voted that the society be named the William Jarvie Society for Dental Research and that Dr. William Jarvie be elected an honorary member.

Dr. Schroff served ably as president during 1922. Dr. Monasch officiated during 1923, and in 1924, because of the amalgamation of the College of Dental and Oral Surgery with the School of Dentistry of Columbia University, interest in the organization diminished and the society ceased its activities in 1925. On February 7, 1929, the society resumed activity and elected officers. Interest revived, and the organization was again brought into prominent place in the extracurricular life of the school.

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

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

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

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

2009 Birnberg Lecturer

Deborah Greenspan, BDS, DSc

Deborah Greenspan, BDS, DSc is Professor of Clinical Oral Medicine and Chair of the Department of Orofacial Sciences, School of Dentistry and Clinical Director of the Oral AIDS Center at the University of California San Francisco School of Dentistry. Deborah Greenspan is President of the International Association for Dental Research and has been named an Ambassador in Research!America's Paul G. Rogers Society for Global Health Research. She is Immediate Past Chair of the San Francisco Division of the University of California Academic Senate and has served on many UCSF Senate committees, including Academic Planning and Budget, Equal Opportunity, and the Committee on Committees. She is a Fellow of the American Association for the Advancement of Science, a member of the Institute of Medicine of the US National Academy of Sciences, and in 2000 received the Silver Medal of the Ville de Paris. The ScD(hc) was conferred on her by Georgetown University, the FDSRCS (Hon) by the Royal College of Surgeons of Edinburgh, the honorary DSc from Kings College, University of London, UK, and the DDS(hc) from the University of Sheffield UK.

She has served as a consultant to the Centers for Disease Control, the Health Resources Service Administration, the Agency for Health Care Policy and Research, and the American Dental Association Council on Scientific Affairs and has served as a member of the Dental Products Panel for the Federal Drug Administration. Her research interests include: clinical, laboratory, and epidemiological studies relating to the oral manifestations of AIDS; the oral effects of cancer therapy; and the development of new therapeutic approaches for oral mucosal and salivary gland diseases. She is a member of the AIDS Research Institute, the Cancer Center, and the graduate Group on Oral and Craniofacial Sciences.

Birnberg Research Program

WEDNESDAY, March 25, 2009, 2:00-5:00 P.M.

THURSDAY, March 26, 2009, 12:00-2:00 P.M.

WEDNESDAY, MARCH 25th, 2009

2:00-5:00 P.M.

Student Table Clinic and Research Poster Session

Riverview Lounge, Hammer Health Science Center, 4th Floor

THURSDAY, MARCH 26th, 2009

12:00-1:00 P.M.

Birnberg Lecture

Dr. Deborah Greenspan, 2009 Birnberg Award Recipient

Professor of Oral Medicine

Chair of the Department of Orofacial Sciences

Leland A. and Gladys K. Barber Distinguished Professor in Dentistry

Clinical Director of the Oral AIDS Center

University of California San Francisco School of Dentistry

Amphitheater 5-7, P&S 7th Floor

“Global Oral Health: Implications of the HIV Pandemic”

1:00-2:00 P.M.

Luncheon and Presentation of Awards

Faculty Club, P&S 4th Floor

A Message from the Jarvie President

The future of dentistry lies in research into the problems that beset it, and the William Jarvie Research Society has been offering its share in stimulating interest and serving as a vehicle for scientific growth at CDM. This year, we recorded another year of activity and accomplishment. The overwhelming interest in student research was clearly displayed by the CDM community with a membership total of 90 students. To think that almost one third of the student body is, in one way or another, involved in research is quite inspiring.

The Jarvie Society has grown not only in size but in dedication and motivation as well. This year we approached the traditional Jarvie Lecture Series with a “Student Oriented” theme. In this year’s lectures, student researchers had the opportunity to present their research achievements while their PIs, who are established researchers, provided the audience with a more profound and scientific explanation of their research projects. The result has been wonderful. Immense interest amongst students could be demonstrated by an excellent attendance rate at all four Jarvie lectures we hosted this year.

In addition to the Jarvie Lecture Series, we represented the Jarvie Society at the Club Fair Day to the entire student body and hosted a Birnberg Poster Guide Seminar for presenters at the Birnberg Research Program. The editors of the Society produced an informative Jarvie Newsletter, featuring a research database full of experiences and advice on research and externships from upperclassmen. And of course, this year’s Jarvie Journal is spectacular.

There are many individuals that helped pave the way and solidify another terrific year for the Jarvie Society. Dr. Ira Lamster, Dr. Martin Davis, and Dr. Letty Moss-Salentijn have pledged their commitment from the onset, and we thank them tremendously. Dr. Richard Abbott, in his position as our faculty advisor and also Director of the Office of Research Administration, has been a true blessing to the Jarvie Society. Dr. Abbott has helped us grow and continues in helping us pursue our goals. Our other faculty advisor, Dr. Jeremy Mao, has yet again provided the much needed guidance and support to allow Jarvie to thrive. In addition, the Society proudly recognizes Dr. Jeremy Mao (Director of Tissue Engineering and Regenerative Medicine Laboratory), Dr. Burton L. Edelstein (Professor and Chairman of Social and Behavioral Sciences), Dr. Srikala Raghavan (Assistant Professor), Avital Harari (PhD Candidate), Neeraj Panchal (CDM’ 2009), Aisling O’Connor (CDM’ 2010), Eric Frank (CDM’ 2011), and Caitlin Magraw (CDM’ 2012). They have all made the 2008-2009 Jarvie Lecture Series a success thanks to their wonderful contributions and effective presentations.

On behalf of the entire Jarvie Society, I would like to thank Jeff Nichelini, Debbie Weng, Petro Matsyshyn, and Betty Huang for the unequivocal dedication they have displayed as members of the executive board. Our editors, Steven Nadler, Caleb Kim, Tyler Kim, and Mariel Nortick have spent countless hours producing this year’s Jarvie Journal and Newsletter. Their work has been remarkable. And finally, I thank the members of this year’s Jarvie Society. Without each and every one of you, it would have been impossible to achieve our goals.

Our student body and faculty at the College of Dental Medicine at Columbia University continually demonstrate that we do indeed value the significance of scientific/epidemiologic research and, by doing so, support and contribute to the evolving nature of dentistry. This journal celebrates the work of our fellow colleagues. It has been a pleasure serving as President.

To another incredible year of experience, growth and achievement – thank you!

Zi Wang
Class of 2010

2009 William Jarvie Society Membership

Officers:

Editor-in-Chief	Deborah Weng '09
President:	Zi Wang '10
Vice President:	Jeffrey Nichelini '10
Secretary:	Betty Huang '09
Treasurer:	Petro Matsyshyn '11
1st Year Liaison:	Eric Frank '11
Newsletter Editor:	Steven Nadler '11
Associate Editors:	Junhyck Kim '10
	Min H. Kim '10
	Mariel Nortick '10

Advisors:

Dr. Richard Abbott
Dr. Jeremy Mao

Members:

Mary Ballard	Idar Hsin	Won Hee Lee	Barnali Roy
Kavita Bhalala	Hsu Lisa	Xiaoyu Ma	Fariha Samad
Leslie Blackburn	Betty Huang	Caitlin Magraw	Matthew Schorr
Paul Cantelmi	Michael Huang	Petro Matsyshyn	Rupali Shah
Thomas Chae	Tener Huang	Aaron Myers	Pooria Shahin
Ray Cheng	Ahrin Huh	Steven Nadler	Edward Shamich
Jer Wei Chiang	Cha Hur	Adele Newell	Davis Simhaee
Jenny Chung	Grace Sun Ae Hur	Jeffrey Nichelini	Kimberly Soleimani
Minh Dau	Gowhar Iravani	Tao Ning	Paul Son
Janish Desai	Paul Jones	Mariel Nortick	Megan Swanson
Hai Do	Steve Han Yoon Jun	Aisling O'Connor	Shahnaz Tendulkar
Emily Driesman	Diana Kim	Nana Odoom	Ryan Turner
Eric Frank	Junhyck Kim	Justin Ohnigian	Lisa Van Eyndhoven
Robert Geiman	Min H. Kim	Cassandra Pagal-Sussman	Andy Wan
Tamar Gruenbaum	Mina Kim	Marc Pan	Zi Wang
June Harewood	Brandon Knapp	Neeraj Panchal	Deborah Weng
Abel Hernandez	Bernard Lam	Byoung Gyu Park	Catherine Woo
Karin Herzog	Nicole Lambert	Victoria Park	Sukbum Yoo
Matthew Hickin	Gloria Lee	Bradley Pinker	Jeremy Zuniga
Amanda Hockstein	Stephenie Lee	Staci Robinson	

Visit us at www.dental.columbia.edu/jarvie

Pre-Doctoral Student Abstracts

Investigating the Role of $\beta 6$ Integrin in Oral Squamous Cell Carcinoma

Phillip Brinton¹, Srikala Raghavan^{2,*}

¹*College of Dental Medicine, Columbia University, New York, NY;* ²*Department of Oral Surgery & Department of Dermatology, Columbia University, College of Dental Medicine, New York, NY;*

**Faculty Mentor*

Introduction: Integrins are a large family of heterodimeric transmembrane receptors comprising of 18α and 8β subunits that link the extra-cellular matrix (ECM) to the cellular cytoskeleton. Integrins can signal in a bi-directional manner and play a fundamental role in the maintenance of tissue integrity and in the regulation of cell proliferation, growth, differentiation, migration, and ECM assembly. $\alpha\beta 6$ is an epithelial-specific integrin that binds to the ECM proteins fibronectin, vitronectin, tenascin, and the latency associated peptide (LAP) of TGF- β . Unlike the other epithelial integrins, $\alpha\beta 6$ is not expressed constitutively by healthy epithelia but is upregulated during wound healing and at the invasive front of carcinomas. In squamous cell carcinomas (SCCs), variable loss or reduced expression of $\beta 1$ and upregulation of $\nu\beta 6$ have been shown to correlate to loss of ECM integrity and increased invasion. The mechanism for the increased invasion is thought to be, in part, through the $\nu\beta 6$ -dependent upregulation of the type IV collagenase MMP-9. We hypothesize that there may be an intricate interplay between integrin $\beta 1$ and $\beta 6$ in the maintenance of basement membrane (BM) integrity. Integrin $\beta 6$ may be responsible for degrading the ECM by activation of matrix metalloproteinases (MMPs) while $\beta 1$ integrin may be responsible for maintaining ECM integrity. The tipping of the balance of these integrins, overexpression of $\beta 6$ and down regulation of $\beta 1$, may contribute to cell migration and invasion.

Objective: The objective of this study was to investigate the impact of increased levels of $\beta 6$ on proliferation and migration of poorly invasive oral squamous cell carcinoma cell lines (OSCC).

Materials and Methods: 3 poorly-moderately invasive SCC cell lines (SCC25, SCC15, and SCC9) were infected with retroviruses expressing $\beta 6$ -FLAG (a tagged version of $\beta 6$). The resulting cell lines SCC25 $\beta 6$, SCC15 $\beta 6$, and SCC9 $\beta 6$ all expressed elevated levels of $\beta 6$ integrin. Using the non-infected cell lines as controls, cell proliferation assays were conducted to determine the impact of increased $\beta 6$ on cell growth. Scratch wound assays were conducted to determine the impact of increased $\beta 6$ on cell migration.

Results and Conclusions: The increased expression of $\beta 6$ in the SCC25 and SCC15 cell lines did not have much of an effect on cell proliferation or migration. The effects of increased $\beta 6$ expression in SCC9 cells are currently being tested, and the results will be presented.

Discussion: In the future, we plan to assess the effect the LAP of TGF β on cell migration of all the SCC $\beta 6$ lines. The relationship between $\beta 1$ and $\beta 6$ integrin will also be explored using these cell lines.

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Interaction of $\beta 6$ Integrin and Cytoskeletal Protein Talin

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Introduction: The integrins are heterodimeric transmembrane receptors that connect the cytoskeleton with the extracellular matrix (ECM). Cells adhere to the ECM via focal adhesions. Focal adhesions (FAs) are sites where more than 100 proteins are found as a “signalosome”, having direct and indirect interactions with the cytoplasmic domain of integrins. Talin is a very important protein that is found at FAs. The recruitment of talin to the cytoplasmic domain of integrin $\beta 1$ and $\beta 3$ is considered to be the first step in integrin activation and signaling. In an attempt to dissect the differences in the focal adhesions nucleated by $\beta 1$ versus $\beta 6$ integrins, we had previously shown that talin bound very weakly to the cytoplasmic domain of $\beta 6$ integrin compared to $\beta 1$ integrin.

Objective: To investigate the consequences of this weak talin binding on the signaling mediated via $\beta 6$ integrin.

Materials and Methods: GST pull-down assays were performed using $\beta 1$ and $\beta 6$ cytoplasmic tails; N-terminally tagged Glutathione S-transferase (GST) fusion proteins were generated. The proteins were expressed in BL21 bacterial cells and purified using the sarkosyl extraction method. For the *in vitro* pull-down assays, cell lysates were made either from fibroblasts (AM12 cells) or keratinocytes. The cell lysates were incubated with the GST fusion proteins and then washed and loaded onto 10% acrylamide gels. Immunoblotting was performed using the anti-talin antibody (sigma), and the blots were developed using the Licor system.

Results and Conclusions: $\beta 6$ integrin displayed very poor binding with talin in the GST pull-down assays as has been previously established by us, but when the buffer conditions were changed, it was seen that $\beta 6$ cytoplasmic tail could bind talin. Both the buffers used had 50mM Tris-HCl pH 8.0, 2mM EDTA pH 8.0, and 150 mM NaCl. In addition, one buffer had Triton (1%), Sodium Deoxycholate (1%), and SDS (0.1%) as detergents, and another buffer had only NP40 (2%) as the detergent. In the presence of only NP40 as the detergent, $\beta 6$ could bind talin. NP40 is considered to be a very mild detergent and is often used in protein biochemistry to trap protein-protein interactions that are not very robust. Talin binding to $\beta 6$ cytoplasmic domain was absent in the presence of the stronger and harsh detergent SDS that often disrupts protein-protein interactions that are mild in nature. Since $\beta 1$ cytoplasmic tail can bind talin in both the buffers, and it is known that talin-integrin interaction is a robust one, it is very interesting that $\beta 6$ can bind talin in only one buffer (which is milder) as compared to $\beta 1$. As talin is very important for integrin activation and focal adhesion turnover, differential binding of talin to $\beta 6$ correlated well with previous results where the focal adhesions nucleated by $\beta 6$ integrin were phenotypically quite different than those formed by $\beta 1$ integrin.

Discussion: We hypothesize that the lack of talin binding to the $\beta 6$ tail may alter the signaling mediated by this integrin. Further studies on protein interactions using $\beta 6$ integrin should reveal the nature of these signaling changes.

Cancer Stem Cell Growth is Attenuated by Doxorubicin-Conjugated Quantum Dots

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Introduction: As a departure that cancer is induced by differentiated cells, an evolving concept in cancer biology is that stem cells give rise to cancer. Although the contribution of cancer stem cells (CSCs) and cancer stromal cells to tumorigenesis is being actively explored, little is known about selective drug targeting against these cells. A new generation of chemotherapies will selectively target only CSCs, cancer cells, or cancer stromal cells rather than healthy host cells. One of the first steps is to identify effective carriers that target selected cancer cell populations. Doxorubicin (Dox) remains the standard of care for metastatic tumors of connective tissues with a 20-25% response rate¹. Quantum dots (QDs) have recently been shown to label and track rapidly dividing tumor or stem cells². The objectives of the present study are 1) to conjugate Dox to QDs and determine whether Dox-QD conjugates effectively label tumor cells and 2) to determine whether the growth of sarcoma-initiating cells is inhibited by QD-Dox.

Materials and Methods: ZnS capped CdSe QDs were conjugated to Dox/RGD through covalent binding using EDC (1-Ethyl-3-dimethyl amino propyl carbodiimide). Hos (a non-tumorigenic osteosarcoma) and Skut1B (a tumorigenic leiomyosarcoma) cell lines were incubated with various groups (Control, QD-RGD (30 nM), Dox (22.5 μ M), QD-Dox (0.1 μ M), QD-Dox (0.15 μ M)) suspended in 100 μ L medium. After 3 days, tumor cell proliferation rates were quantified using MTT reagent. QD-Dox conjugates were washed multiple times to remove free Dox. Thoroughly-washed QD-Dox conjugates were tested for effectiveness against sarcoma-initiating cells.

Results: To assess if QD-Dox conjugate was as cytotoxic as Dox alone, we tested its activity against the two sarcoma cell lines. The enhanced cytotoxicity of QD-Dox is likely due to more than one molecule of Dox binding to one QD. Cell metabolic assays showed that Dox-QD conjugate was as cytotoxic as free Dox in attenuating the growth of sarcoma cell lines. Pathological phenotype of the studied sarcoma cells was found, certifying that Skut1B is a cancer cell line.

Discussion: These findings show that QD-Dox is as active as free Dox, providing a rare glimpse of selective targeting of cancer cells. This generic approach is applicable to multiple lineages of cancer stromal cells and other metastatic cancer cells. We are performing *in vivo* studies to examine the efficacy of cancer attenuation by doxorubicin-conjugated quantum dots.

References: ¹Spira AI, Ettinger, DS. The use of chemotherapy in soft tissue sarcomas. *Oncologist*. 2002; 7:348-359. ²Shah BS, Clark PA, Muioli EK, Strosio MA, Mao JJ. Labeling of mesenchymal stem cells by bioconjugated quantum dots. *Nano Lett*. 2007;7:3071-3079.

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CTGF and Renin in Diabetic ApoE ^{-/-} Mice: A Role in Atherogenesis

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Introduction: Connective tissue growth factor (CTGF) is an embryonic lethal gene critical to embryogenesis. It also plays a role in growth and development in key processes such as osteogenesis and wound healing¹. Overexpression of CTGF in various organs such as the kidney, lung, heart, and vasculature has been described as profibrotic. Dr. Nuglozeh had previously histologically demonstrated cardiac hypertrophy in his transgenic mouse overexpressing CTGF. Others also localized CTGF production to osteoblasts where secreted CTGF is endocytosed by various cells including megakaryocytes. During atherogenesis, platelets are attracted to the area and degranulate to release various cytokines and chemoattractants, including CTGF. CTGF was demonstrated to be a strong chemoattractant for monocytes and lymphocytes in atherosclerotic lesions². It induces also alkaline phosphatase activity where it contributes to calcium deposition in atherosclerotic plaque. It is proapoptotic in smooth muscle cells and causes degeneration of the fibrous cap leading to plaque rupture³. We developed this study to establish a new paradigm of vascular tone control in atherosclerotic plaques of diabetic mice. Since CTGF is regulated by the renin-angiotensin-aldosterone system (RAAS) system, in particular angiotensin II, we also looked at the localization of renin in these plaques to try to determine if there was overlap between renin and CTGF.

Objective: Our objective was to visualize CTGF and renin localization in atherosclerotic plaques in the aorta of diabetic mice. Since the RAAS system should be involved in the induction of CTGF, we wanted to test this relationship. We hypothesized that both renin and CTGF would be significantly overexpressed in the diabetic mice, and CTGF should be localized throughout the plaque of the aorta.

Materials and Methods: Mouse specimens used for this study were control mice and streptozotocin-induced diabetic ApoE ^{-/-} mice. Mice were sacrificed, and the aortas were harvested. Frozen sections of the aortas were made and fixed in acetone. A delimiting pen (DAKOpen ImmunoPen) was applied to provide a hydrophobic barrier and retain solutions. The sample sections were washed with PBS, blocked with CAS-block, and incubated overnight at -4°C with 1:200 CTGF primary rabbit antibody (SantaCruz) and 1:500 renin primary rabbit antibody (SantaCruz). The sections were then incubated in 1:200 biotinylated anti-rabbit secondary antibody for 30 minutes followed by incubation with 1:500 fluorescent Avidin in PBS for 30 minutes at room temperature. The slides were then counterstained with hematoxylin, dehydrated, and fixed.

Results and Conclusions: Our immunohistochemical analysis showed atherosclerotic lesions in streptozotocin-induced diabetic mice but not in control mice. The aortic walls of the diabetic mice were fibrotic with a large plaque occluding part of the vessel, and the intima walls were thickened. In contrast to the normal aorta, the atherosclerotic aorta was infiltrated by inflammatory cells. CTGF and renin were both localized in the atherosclerotic plaques but were negligible in the control mice. CTGF and renin were localized throughout the plaque and slightly along the luminal border of the intima which was especially true of renin. Lastly, there was much larger localization of renin than there was of CTGF. In conclusion, the results show that CTGF must play a role in atherogenesis and is localized in the plaque and the intima of the aorta. Since renin is localized in the same parts of the aorta, it supports prior research that the RAAS system maybe involved in local regulation of CTGF.

Discussion: CTGF is a known profibrotic growth factor that, as demonstrated in our study, is overexpressed in atherosclerotic plaques. It is induced by the RAAS system, and we have shown that factors from the RAAS system, particularly renin, are localized to the same areas. Future studies should include western blots to access the level of CTGF in atherosclerotic lesions and subsequently to determine feedback mechanisms between CTGF and angiotensin II, and CTGF and renin in transgenic animal models overexpressing CTGF. If the RAAS system regulates local CTGF in atherosclerotic plaques, it is possible that CTGF may have a regulatory effect on the RAAS system. CTGF may positively feedback on the RAAS system thereby exacerbating cardiovascular problems. Studying CTGF in mouse models may lead to CTGF drug targeted therapy against atherosclerosis and other fibrotic illnesses.

References: ¹Lau L, Lam S. The CCN family of angiogenic regulators: the integrin connection. *Exp Cell Res*. 1999; 248:44-57. ²Iwona C, Yilmaz A, et al. Connective tissue growth factor is overexpressed in complicated atherosclerotic plaques and induces mononuclear cell chemotaxis in vitro. *Arterioscler Thromb Vasc Biol*. 2005; 25:1008-1013. ³Hishikawa K, N T, Fujii T. Connective tissue growth factor induces apoptosis via caspase 3 in cultured human aortic smooth muscle cells. *Eur J Pharmacol*. 2000; 392:19-22.

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Expression Levels of pChk2 and γ H2AX Following Irradiation

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Introduction: A large segment of a population may be exposed to ionizing radiation during an accident or nuclear bioterrorist event. Such potential events demand an efficient method to conduct mass scale screening within a few days after the exposure. Our goal is to devise a high-throughput assay that measures expression of the signature biomarkers for radiation exposure in human tissue samples obtained by non-invasive methods. We hypothesize that activated checkpoint kinase 2 (pChk2) and histone 2AX (γ H2AX), DNA damage response molecules, are produced in irradiated cells and may serve as signature molecules of exposure.

Objectives: This study tests feasibility of measuring the expression levels of pChk2 and γ H2AX in oral exfoliative cells non-invasively collected using a mouthwash technique. Our ultimate goal is to devise an efficient and high-throughput method to identify those exposed to ionizing radiation.

Materials and Methods: A total of 100 healthy individuals undergoing routine dental radiographic examination (23.4 mGy) were included in the study. The exfoliated oral epithelial cells were collected twice using a mouthwash: 1) before and 2) 20 minutes after the radiographs were taken. The epithelial cells were cytopun onto glass slides for immunohistochemical analysis for pChk2 and γ H2AX. The intensity of nuclear staining in 50 randomly selected cells was analyzed using a software system (Becton Dickinson).

Results and Conclusion: Both biomarkers showed statistically significant increased levels of expression after the radiation exposure. The mean intensity for pChk2 before the radiation was 0.114 (SD= 0.035) and after the radiation was 0.139 (SD= 0.038). For γ H2AX, the mean intensity before the radiation was 0.105 (SD= 0.033) and after the radiation was 0.125 (SD= 0.052). A paired t-test showed $p < 0.001$ for pChk2 and $p < 0.001$ for γ H2AX. Our data demonstrate that it is feasible to measure biomarker expression in exfoliated oral cells for assessment of radiation exposure status. Based on this 'proof-of-concept' study, a future investigation can assess the dose-response and the time-course for the biomarkers and define a dose and time range that yields highest sensitivity.

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Integrin $\alpha\beta6$ Expression in Hair Development

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Introduction: Integrins are a large family of $\alpha\beta$ heterodimeric transmembrane receptors that link the cellular cytoskeleton to the extracellular matrix (ECM). Integrin signal transduction occurs in a bidirectional manner and plays critical roles in cell migration, adhesion, proliferation, differentiation, and apoptosis. While many integrins are very promiscuous and bind to a plethora of partners, $\beta6$ exclusively binds to $\alpha\upsilon$. Prenatally, $\alpha\upsilon\beta6$ is expressed in the developing lungs, kidneys, and skin. However, postnatally, $\alpha\upsilon\beta6$ expression is restricted to the epithelium where it binds to proteins in the ECM. Integrin $\alpha\upsilon\beta6$ is not expressed by healthy adult epithelium but is upregulated during carcinogenesis, wound healing, and inflammatory responses.

In addition to an altered immune system response, $\beta6$ knock-out mice display juvenile baldness indicating that $\beta6$ may play an important role in hair development. Hair development can be divided into two distinct stages: 1) embryonic hair follicle morphogenesis from embryonic day 15.5 to postnatal day 20 and 2) the adult hair cycle which begins at postnatal day 20 and continues throughout life. Embryonic hair morphogenesis involves epithelial-mesenchymal interactions where the hair follicle begins to proliferate and grow downwards, the dermal papilla of the hair follicle forms, and the matrix cells proliferate into various lineages of the hair follicle. Once the hair follicle is fully formed, it progresses through stages of growth (anagen), regression (catagen), and rest (telogen) of the adult hair cycle. At the end of telogen, stem cells within the bulge region of the hair follicle are activated to give rise to the new anagen hair follicle.

Objective: The purpose of the study is to try to understand the role of integrin $\alpha\upsilon\beta6$ in stem cell migration, hair follicle morphogenesis, and the adult hair cycle.

Materials and Methods: A developmental time course of $\beta6$ expression from embryonic day 15.5 to postnatal day 65 was used to examine the expression of integrin $\alpha\upsilon\beta6$ during embryonic development and the first two adult hair cycles. Dorsal epithelium from wild-type mice of the appropriate age was embedded in OTC, and 10 μm serial sections were cut on a cryostat. Sections were stained with hematoxylin and eosin, and immunohistochemistry was performed to visualize $\beta6$, Lam5 (a major component of the epithelial basement membrane), and cell nuclei (using DAPI).

Results and Conclusions: Integrin $\alpha\upsilon\beta6$ appears to be highly expressed throughout the developing hair follicle during embryonic hair follicle morphogenesis. In catagen and telogen of the adult hair cycle, $\alpha\upsilon\beta6$ expression is localized to the bulge region of the hair follicle where the stem cells are located. During anagen of the adult hair cycle, integrin $\alpha\upsilon\beta6$ is expressed throughout the regenerating hair follicle in addition to being expressed in the bulge region.

Discussion: Embryonic hair follicle morphogenesis and adult hair cycling both involve invasion of the developing hair follicle into epithelium and are, in a sense, controlled wounds. Since integrin $\alpha\upsilon\beta6$ is normally expressed during wound healing, $\alpha\upsilon\beta6$ may mediate similar cellular processes involved in controlled wounding as it does in traumatic wounding. The ultimate goal of this research is to examine the interplay between integrin $\beta1$ and $\beta6$ in squamous cell carcinoma.

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Characterization of Receptor Polysaccharide (RPS)-Bearing Flora from an Individual

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Introduction: Colonization of the human tooth surface is initiated by a limited number of different gram-positive bacteria, primarily different species of streptococci. These bacteria coaggregate with each other and with other oral species. These coaggregations typically involve binding of thread-like structures referred to as fimbriae on the surface of species such as *Actinomyces naeslundii* to surface polysaccharides referred to as receptor polysaccharides (RPS) on different streptococci in the early biofilm community. These interactions appear to play a role in formation of dental plaque biofilms. Biofilm communities rich in early colonizers (i.e., streptococci and actinomyces) provide a habitat for additional species that are associated with the etiology and pathogenesis of dental caries and periodontal disease.

Six different receptor polysaccharides (RPS) have been identified from specific strains of *Streptococcus oralis*, *S. gordonii*, and *S. sanguinis*. Each type contains a host-like recognition motif, either GalNAc β 1-3Gal (Gn) or Gal β 1-3GalNAc (G). All Streptococci with Gn or G types of RPS coaggregate with actinomyces, but only streptococci with Gn RPS coaggregate with *S. sanguinis* SK1 and *S. gordonii* DL1. The GalNAc binding adhesions of these strains do not recognize G-types of RPS. Therefore, the occurrence of Gn and G type RPS on different streptococci may influence biofilm development.

The number of different RPS-bearing streptococci that are harbored by individual patients is not well defined. The present study was initiated to enumerate the bacteria in the early plaque biofilm of a single patient.

Materials and Methods: Samples of early supragingival dental plaque were taken from lower incisors with a sterile cotton swab. The samples were plated on Todd Hewett agar for the isolation of single colonies. Individual colonies were arrayed on two plates: one was used for colony immunoblotting and the other to retrieve RPS-producing colonies. Colony immunoblotting was performed with a pool of different RPS-specific antibodies against serotypes 1, 2, 3, and 4/5. RPS-producing colonies identified by these antibodies were then screened by dot blotting with individual antibodies to determine the serotype of each isolate. The receptor types of these isolates were determined by coaggregation assays performed with *A. naeslundii* 12104. The clonality of different RPS-producing isolates was determined by Repetitive Element PCR (REP-PCR). The gene *sodA* was sequenced from representative isolates to identify to which species the bacteria belong.

Results and Discussion: The RPS types identified from the human sample included thirty six 1Gn, two 2Gn, one 3G, and five 4Gn. All the Gn type coaggregated with *A. naeslundii* 12104, and all G type coaggregated with both *A. naeslundii* 12104 and *S. sanguinis* SK1. Thirteen different clones of *Streptococci* were found, and each was sequenced to identify these bacteria to species.

From the chimpanzee samples, 76 colonies from THB-plates and 20 from mupirocin-plates (i.e. putative Actinomyces) were selected. None the THB isolates reacted with RPS-specific antibodies in immunoblotting. Three of the strains (T17, T20, and T39) coaggregated with *A. naeslundii* 12104 and with *S. sanguinis* SK1. They also coaggregated with two of the putative chimp *Actinomyces* strains (M13 and M17). Further studies are in progress to identify and compare the chimp oral isolates with members of the human oral flora. This work is designed to provide insight into the coevolution of bacteria with the host oral environment.

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Identifying Functional Domains of $\beta 1$ Integrin Required for ECM Integrity

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Introduction: Integrins are a large family of heterodimeric trans-membrane receptors comprised of $\alpha\beta$ subunits that link the extracellular matrix (ECM) to the cellular cytoskeleton. Integrins signal through the cell membrane in a bi-directional manner. These signaling events regulate cellular processes such as cell adhesion, migration, proliferation, differentiation, and apoptosis. The predominant epithelial integrins are $\alpha 3\beta 1$ and $\alpha 6\beta 4$, both of which are receptors for laminin 5, a major component of the epithelial basement membrane. We previously generated the conditional $\beta 1$ integrin knock-out (KO) in the skin epidermis and showed that these mice exhibited gross morphological defects in their skin at the level of the dermal-epidermal junction (DEJ), including a complete failure of the BM to organize. The challenge that faces us now is to dissect the molecular pathways used by $\beta 1$ integrins in maintaining ECM integrity.

Objective: The objective of this project was to rescue the $\beta 1$ KO phenotype by reintroducing a FLAG-tagged wild-type (WT) copy of $\beta 1$ into the KO keratinocytes. The ultimate goal of this project is to test the hypothesis that different domains of integrins may have distinct signaling and/or structural function in the regulation of basement membrane assembly/organization.

Materials and Methods: To rescue the $\beta 1$ -KO phenotype, full-length FLAG tagged $\beta 1$ integrin construct was re-expressed in the $\beta 1$ KO keratinocytes using lentiviral transduction. *In vitro* characterization of the rescued cells was performed, and *in vivo* characterization of the rescued cells was performed by investigating the reassembly of the epithelial basement membrane using skin reconstitution (grafting) studies on the backs of NSWNU mice. Immunostaining will also be done to show FLAG expression in the rescued epithelia.

Results and Conclusions: $\beta 1$ KO keratinocytes failed to form hair and skin in grafting experiments. Grafting experiments using $\beta 1$ KO keratinocytes rescued with the FLAG tagged $\beta 1$ integrin construct did show hair and skin formation. NSWNU mice have abnormal, sparse white hairs; thus the cellular origin of the new skin and hair was easily distinguished as being from the rescued keratinocyte grafts and not the host. Future immunostaining for the presence of FLAG should also prove the $\beta 1$ protein expressed in these grafts to be the recombinant form from the rescued keratinocytes.

Discussion: Rescuing $\beta 1$ expression in KO keratinocytes rescues the wild type phenotype of hair and skin formation. This shows that $\beta 1$ expression plays a fundamental role in this process. Now that this correlation has been shown, and the rescue method validated, future studies can be done using chimeric $\beta 1$ constructs in order to identify the functional domains of the protein.

Identification of $\beta 6$ Integrin Cytoplasmic Domain Interacting Proteins

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Introduction: Integrins are a large family of heterodimeric transmembrane receptors comprising of 18α and 8β subunits that link the extra-cellular matrix (ECM) to the cellular cytoskeleton. Integrins can signal in a bi-directional manner and play a fundamental role in the maintenance of tissue integrity and in the regulation of cell proliferation, growth, differentiation, migration, and ECM assembly. The predominant epithelial integrins are $\alpha 3\beta 1$ and $\alpha 6\beta 4$, both of which are receptors for laminin 5, a major component of the epithelial basement membrane. In contrast, $\alpha v\beta 6$ is not expressed constitutively by healthy epithelia but is upregulated during wound healing and at the invasive front of carcinomas.

Objective: The goal of this study is to identify the intracellular proteins that interact with the cytoplasmic domain of $\beta 6$ in order to better understand the signaling mediated by this integrin. Previous studies identified 21 intracellular proteins that interact with the cytoplasmic domain of $\beta 1$; however, little is known about the proteins that interact with the cytoplasmic domain of $\beta 6$. Understanding the biology of $\beta 6$ integrin is important as it is highly expressed in cancers of various origins including lung, breast, pancreas, ovary, and skin.

Materials and Methods: N-terminally tagged GST (Glutathione S-transferase) fusion proteins were generated with the $\beta 1$ and $\beta 6$ cytoplasmic domains. The proteins were expressed in BL21 bacterial cells and purified using the sarkosyl extraction method. For the *in vitro* pull-down assays, cell lysates were made from either fibroblasts (AM12 cells) or keratinocytes. The cell lysates were incubated with GST- $\beta 1$, GST- $\beta 6$, and GST beads, washed, and loaded onto 10% acrylamide gels, stained with coomassie, and interacting proteins were detected. The bands in the gel that represented proteins that bound to GST- $\beta 6$ and not GST alone were cut out and sent out for mass spectroscopy analysis (<http://cpmcnet.columbia.edu/dept/protein/index.html>).

Results and Conclusions: Using GST PD assays and mass spectrometry, FAK, ILK, paxillin, and vimentin (which have previously been shown to interact with $\beta 1$ integrin) were identified as $\beta 6$ cytoplasmic domain interacting proteins. In addition, we are in the process of further analyzing some new $\beta 6$ interacting proteins.

Discussion: We were able to identify differential binding of proteins to the cytoplasmic domains of integrins $\beta 1$ and $\beta 6$, which may enable us to identify the differences in signaling pathways downstream between these two integrins. In addition, these data may provide a valuable insight into the mechanism by which $\beta 6$ is of upregulated in cancers.

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Treatment of Fibrotic Diseases by Inhibition of the Connective Tissue Growth Factor Pathway

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Introduction and Objectives: Excessive fibrosis is the main culprit in several diseases and abnormalities including liver cirrhosis and hypertrophic scar formation. The connective tissue growth factor (CTGF) gene is expressed during wound healing, leading to angiogenesis, fibroblast maturation, and extracellular matrix synthesis. This factor is also the major inducer of extracellular matrix production in organ fibrosis, and its gene is overexpressed in fibrotic lesions in renal, pulmonary, cardiac, liver, and pancreatic fibrosis as well as keloids and hypertrophic scars due to inflammatory processes. The CTGF functions by activating p38 MAP kinase and tyrosine kinase A (Trk A) receptors. The goal of this study is to inhibit these receptors and measure the reduction in fibroblast differentiation and extracellular matrix production. The factors used to inhibit p38 MAP kinase and Trk A are SB 220025 and K252a, respectively. Fibrosis reduction can be used in the treatment of the patient undergoing myocardial infarction, liver cirrhosis, wound healing with secondary intention, and other diseases caused by undesirable fibrosis.

Materials and Methods: Human bone marrow mesenchymal stem cells (MSCs) were cultured in growth medium consisting of Dulbecco's modified Eagle's minimal essential medium (DMEM) with 10% FBS and 1% antibiotics. The cultures were treated with CTGF and incubated for eight weeks at 37°C. The activation of p38 MAP kinase and Trk A receptors by CTGF was evaluated by measuring the amount of the phosphorylated receptor proteins using the western blot technique.

The inductive effects of CTGF and the inhibitory effects of SB 220025 and K252a were then tested. Cultured MSCs were treated with CTGF and CTGF plus different concentrations of inhibitors. The two inhibitors were used separately and never in combination with each other. The untreated MSC culture was used as the control. The treatment lasted four weeks. After this time, the cultures were examined microscopically after trichrome staining.

An immunodeficient mouse model was used as the animal model in this study. Human keloids were implanted in the mice subcutaneously and observed for one week. Subcutaneous injection of PLGA microspheres encapsulating the inhibitor solutions was the means of the inhibitors' application *in vivo*. Each mouse was locally injected with only one type of inhibitor for two weeks. The animals were then sacrificed, and the keloid implants were examined microscopically after the H&E and trichrome staining.

Conclusion: CTGF induces the phosphorylation of p38 MAP kinase and Trk A receptors and leads to the differentiation of bone marrow MSCs to fibroblasts. In addition, CTGF increases the collagen synthesis by fibroblasts. The inhibitors of p38 MAP kinase and Trk A both inhibit fibroblast differentiation and collagen synthesis *in vitro*. These inhibitors also decrease collagen synthesis and increase cellularity and vascularity of keloid masses *in vivo*. However, the Trk A inhibitor demonstrated much greater effects than the p38 MAP kinase inhibitor. The results indicated that CTGF might be the potential drug target for anti-fibrosis therapy. Further studies are required before moving forward to human studies.

Effects of Pamidronate on Primary Human Oral Fibroblasts

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Introduction: Bisphosphonates (BP) are a widely used class of drugs employed in the prevention and treatment of postmenopausal and steroid-induced osteoporosis, Paget's disease of bone, hypercalcemia of malignancy, multiple myeloma, and bone metastases associated with breast, prostate, lung, and other soft tissue tumors. During the past several years, numerous reports have noted the occurrence of osteonecrosis of the maxillofacial bones in patients receiving bisphosphonates. Many, but not all, of the affected patients had dental extractions or surgical manipulation prior to the development of Osteonecrosis of the Jaws (ONJ). These uncontrolled reports suggest an association between ONJ and bisphosphonate therapy. Whether or not the ONJ lesion initiates in the oral soft tissues or derives from the underlying bone has not yet been determined.

Objective: We are testing the hypothesis that bisphosphonates are toxic to oral fibroblasts at clinically relevant levels. These findings will support the theory that ONJ is initiated in the soft tissue and results from an inhibition of normal wound healing of the fibroblasts. Furthermore, the alteration of oral soft tissue wound healing secondary to BP exposure can be restored by the addition of appropriate exogenous growth factors.

Materials and Methods: Primary oral fibroblasts were obtained from discarded surgical tissue and exposed to pamidronate (Sigma, St. Louis, MO) at clinically relevant doses. Cellular proliferation was measured using a MTS/PMS reagent-based kit (Promega, Madison, WI), and wound healing was examined with a scratch assay. To determine whether oral keratinocytes undergo apoptosis following exposure to pamidronate, TUNEL, and caspase-3, apoptosis assays were performed.

Results and Conclusions: Cellular proliferation and migration of oral fibroblasts were shown to be strongly inhibited by pamidronate at 0.03mM after 96 hours of exposure. Higher concentrations caused cells to detach from the culture plates after 72 hours. TUNEL and caspase-3 assays showed that 0.03mM pamidronate induced apoptosis after 96 hours of exposure. Cells cultured with 0.06mM and 0.1mM pamidronate were apoptotic by 48 hours.

Discussion: While it has been shown that bisphosphonates can cause apoptosis in fibroblast cell lines, no study has been done with primary oral fibroblast cell cultures. Our results show that proliferation and wound healing ability of primary oral fibroblasts are significantly reduced by pamidronate at clinically relevant levels. In addition, our findings demonstrate that primary oral fibroblasts are more sensitive to pamidronate than both oral keratinocytes and osteoblast-like cells derived from alveolar bone from previous studies. This suggests that it may be the fibroblasts which are the initiation point for ONJ lesions. Ongoing experiments include testing other bisphosphonates and using growth factors to see if the inhibitory and/or toxic effects of pamidronate on primary oral fibroblasts can be reversed.

Creation of a Fetal Skull Atlas Using Cone Beam Computed Tomography

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Introduction: Since the late 1970s, little comprehensive research involving radiographic imaging of the fetal skull has been published. The Cranium of the Newborn Infant: An Atlas of Tomography and Anatomical Sections¹ was released in 1977 in anticipation of further fetal skull studies using more advanced imaging modalities. To date, only limited studies have been completed using computed tomography (CT).

Objective: A primary intent of this project is to update and improve the Pierce, Mainen, and Bosma atlas, which was limited to surface tomograms that could not capture the intricate anatomy of the fetal skull. Enhanced imaging capabilities of cone beam computed tomography (CBCT) make it possible to view internal skull structures previously difficult to visualize. An additional objective is to create an interactive video atlas of streaming annotated CBCT images in coronal, axial, and sagittal planes. Ultimately, it is our goal to add to the scientific literature a digital and printed fetal skull atlas that can be used as a reference for subsequent studies regarding prenatal growth and development.

Materials and Methods: Nine fetal skulls from a pre-existing collection in the Department of Anatomy and Cell Biology of Columbia University College of Physicians and Surgeons were imaged. Nothing is known about the ages of the specimens or the circumstances preceding skull acquisition. Using Imaging Sciences International's Classic i-CAT™ Cone Beam 3-D Imaging System in Vanderbilt Clinic's Division of Oral & Maxillofacial Radiology, skulls were exposed to a standard 20 second scan (120 kV, 23.87 mAs, and 0.4 mm voxel size) and a high resolution 40 second scan (120 kV, 46.72 mAs, and 0.25 mm voxel size). i-CAT scans were reviewed with accompanying i-CAT Vision® software and specific images selected for further study. Images were uploaded to an online library, and anatomic landmarks were labeled using the Image Annotation Tool created by the Columbia Center for New Media Teaching and Learning (CCNMTL). An interactive video atlas of annotated continuous CBCT images was created in partnership with CCNMTL, using Camtasia Studio® and QuickTime Pro® softwares. A printed atlas of images was designed using Microsoft PowerPoint®, Adobe Photoshop®, and Adobe Acrobat Professional® softwares.

Discussion: Several studies^{2,3} have concluded that CT is a preferred medium for fetal skull development and morphology research. The Cone Beam 3-D Imaging System allows exact anatomic imaging in virtually limitless planes thereby minimizing the need for involved dissections that may damage or compromise the original specimens. Recent fetal skull research utilizing CT has mainly focused on specific regions such as the developing skull base⁴ and osseous labyrinth⁵. Missing from the literature is a complete atlas of CT images demonstrating the size, location, and approximation of the various fetal skull components. Highlights of our body of work include improved radiographic images of the developing teeth, optic canals, temporal bones, and temporomandibular joints. It is our hope that our project will increase understanding about prenatal developmental anatomy and encourage additional studies relating to normal and abnormal craniofacial growth in the fetus.

References: ¹Pierce RH, Mainen MW, Bosma JF. The cranium of the newborn infant: an atlas of tomography and anatomical sections. *Besthesda: US Dept of Health, Education, and Welfare*. 1977. ²Neumann K, Moegelin A, Temminghoff M, Radlanski RJ, Lanford A, Unger M, Langer R, Bier J. 3-D computed tomography: a new method for the evaluation of fetal cranial morphology. *J Cranio Gen Dev Bio*. 1997;17:9-22. ³Neumann K, Temminghoff N, Radlanski RJ, Langer R, Bier J, Stöblen F, Müller RD. 3-D computed tomography for spatial arrangement of the cranial bones of the human fetus. *Ann Anat* 1999;181:377-383. ⁴Nemzek WR, Brodie HA, Hecht ST, Chong BW, Babcook CJ, Seibert JA. MR, CT, and plain film imaging of the developing skull base in fetal specimens. *Am J Neurorad*. 2000;21:1699-1706. ⁵Porowski L, Radziemski A, Piotrowski A, Skórzewska A, Wosniak W. The foetal development of the human osseous labyrinth in a computed tomographic study. *Folia Morphologica*. 2003;62:281-283.

Platelet-Rich Plasma (PRP)-Enriched Alginate Hydrogel Promotes Angiogenesis of Dental Pulp-Derived Cells

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Introduction: Over 24 million root canal therapies (RCT) are performed annually in the United States¹. During RCT, the diseased dental pulp is removed and replaced with gutta percha. Limitations associated with RCT, such as risk of infection, tooth fracture, and complications due to prosthetic restorations, have prompted interest in pulpal regeneration. Our approach to pulpal repair centers on promoting vascularization and pulp tissue engineering by harnessing the natural healing potential of native pulp and enabling pulpal repair using platelet-rich plasma (PRP) combined with pulp-derived cells in an alginate hydrogel scaffold. Concentrated from plasma, PRP serves as an autologous source of growth factors such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor β -1 (TGF- β 1). Controlled release of these factors^{2,3} are critical for the vascularization and repair of dental and craniofacial tissues⁴.

Objective: To evaluate the response of pulp cells in PRP-containing alginate. Our hypothesis is that the PRP-derived factors released in the hydrogel will promote pulp cell growth and induce angiogenesis.

Methods:

- Cells/Cell Culture: Dental pulp cells were isolated via enzymatic digestion from extracted healthy human teeth. All cultures were maintained in fully supplemented media with 50 μ g/mL ascorbic acid.
- PRP/Pulp Alginate scaffold: PRP was prepared following Tsay *et al*². Dental pulp cells (10,000 cell/scaffold) were first mixed with 2% alginate then combined with PRP (5:2 ratio). The suspension was then gelled in a 6% CaCl₂ solution. The resulting seeding density of both groups was 10,000 pulp cells/scaffold. Pulp cells in alginate without PRP as well as acellular alginate with PRP served as controls.
- End-Point Analyses: Cell growth (n=5) was quantified by Picogreen assay while alkaline phosphatase (ALP) activity (n=5) was measured by enzymatic assay. Collagen deposition was evaluated by picosirius red staining (n=2). Vascularization was assessed by CD31 immunohistochemistry staining and ELISA quantification of VEGF (n=5) in the alginate matrix as well as those released *in vitro*.

Results and Discussion: Effects of PRP on:

- Cell Growth: Pulp cells mixed with PRP in alginate exhibit increased proliferation with the highest cell number found at day 14. In contrast, no significant change in cell number was observed in the pulp control without PRP.
- Mineralization Potential: The addition of PRP significantly decreased pulp ALP activity while no significant change was seen in the pulp cell alginate control group.
- Collagen Deposition: Positive staining for collagen was detected in pulp cells cultured in the PRP-alginate scaffold as compared to the pulp + alginate control.
- Angiogenesis: Positive CD31 staining was found only in cells cultured with PRP. Additionally, VEGF release from PRP-containing alginate matrix increased significantly over time and reached a maximum at 21 days.

Conclusion: Our results suggest that PRP enhances pulp cell proliferation and CD31 expression in alginate hydrogel while decreasing cell mineralization potential. These effects are likely mediated by PRP-derived growth factors with the retention of PDGF in the alginate matrix³ promoting cell growth while VEGF and PDGF are both responsible for CD31 deposition⁵. The apparent decrease in ALP activity is possibly due to the presence of TGF- β 1⁶. Overall these observations demonstrate that PRP combined with alginate is a promising approach for promoting pulp cell growth and potential angiogenesis. Future studies will focus on optimization and evaluation of the multi-factor hydrogel system in promoting pulp repair *in vivo*.

References: ¹ADA Survey. 1999. ²Tsay et al. Differential GF retention by PRP composites. *J Oral Max Surg.* 2005; 63(4):521. ³Lu et al. Controlled delivery of platelet-rich plasma-derived growth factors for bone formation. *J Biomed Mat Res.* 2008; 8694:1128. ⁴Birch et al. In vitro and in vivo assessments of bone formation and applications. *J Craniomaxillofac Surg.* 2002; 30(2):97. ⁵Joussen et al. The role of PDGF receptor inhibitors and PI3-kinase signaling in the pathogenesis of corneal neovascularization. *Inves Ophth and Vis Sci.* 2006; 47:1928. ⁶Shirakawa et al. Transforming growth factor-beta-1 reduces alkaline phosphatase mRNA activity and stimulates cell proliferation in cultures of human pulp cells. *J Dent Res.* 73(9):1509.

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BioPulp: Regeneration of Dental Pulp in Human Teeth without Cell Delivery

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Introduction: Root canal therapy (RCT) is a conventional dental treatment option for a tooth with an infected or injured dental pulp. Although the function of a tooth is frequently restored after RCT, the tooth remains non-vital. Well-documented clinical literature reveals that root canal-treated teeth are susceptible to re-infection, discoloration, increased brittleness, and incidence of fracture. Re-treatment is frustrating to general dentists, endodontists, and patients and is largely attributed to undetected bacterial colonies in accessory root canals or coronal leakage. Although a number of experimental approaches have been proposed to regenerate dental pulp by the delivery of dental pulp stem cells, cell delivery is associated with several impractical issues and difficulty as a therapy. In this study, we hypothesized that the vitality of dental pulp can be restored via regeneration without cell delivery and by bioactive cues.

Objective: To regenerate dental pulp by recruiting endogenous cells into the root canal of human teeth.

Materials and Methods: Nineteen extracted human incisors were disinfected in 10% NaOCl for a minimum of one week. An access opening was made through the crown of each tooth into the pulp chamber. The pulp tissue was extirpated, and the root canal was cleaned and shaped using hand files and rotary endodontic instruments in the same fashion as clinical RCT. All teeth were autoclaved and then randomly divided into 3 groups. Root canals in Group 1 (control) were inoculated with collagen gel only (n=5). Root canals in Group 2 were inoculated with VEGF/BMP7/NGF/PDGF in collagen gel (n=7). Root canals in Group 3 were inoculated with bFGF/BMP7/NGF/PDGF in collagen gel (n=7). The incisors were then implanted subcutaneously into the dorsum of 12-week old mice and harvested 4 weeks afterwards.

Results: Upon harvest, gross examination revealed red pigmentation in the coronal and apical openings in Group 2 and Group 3 but not Group 1. Vascular and granular tissue infiltration was present in the pulp chamber and root canal of teeth treated with growth factors (Groups 2 and 3) in the microscopic sections. Given that no cells were seeded in the collagen gel, the infiltrating tissue must be entirely host-derived. Groups 2 and 3 demonstrated induction of angiogenesis as well as mineralized tissue formation over the pulpal surface of existing native dentin. No induction of these structures was observed in the control group.

Conclusion: The present findings represent the first discovery of regeneration of pulp-like tissue in real-size human teeth and, furthermore, without cell delivery. Bioactive cues including vascular endothelial growth factor (VEGF), basic fibroblast growth factor (bFGF), bone morphogenetic protein (BMP), nerve growth factor (NGF), and platelet derived growth factor (PDGF) are native growth factors that regulate tissue formation during native development and wound healing. Revascularization is an important step in achieving regeneration of pulp tissue since vasculature is essential to the maintenance of viable cells. The present observation of formation of mineralized tissue on the pulpal surface of existing dentin provides new evidence of re-mineralization of coronal or pulpal dentin structures. In summary, dental pulp regeneration is probable by pre-packaged bioactive cues that can be made available for use in dental offices.

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Cartilage Regeneration without Cell Transplantation: Stem Cell Homing and Concurrent Chondrogenesis

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Introduction: Cartilage defects, including temporomandibular joint disorder, may result from arthritis, trauma, or tumors. Such defects are chronic health problems with limited ability to heal. Currently, the predominant approach for cartilage tissue engineering invariably involves cell transplantation. However, cell transplantation for cartilage repair is confronted with critical drawbacks of cell availability, donor-site morbidity, and excessive cost associated with cell manipulation. Stem cell homing is an emerging concept and may circumvent the need for cell transplantation. A cytokine delivery system was devised to recruit surrounding stem/progenitor cells and differentiate them into chondrocytes. Prevalent cell types adjacent to an articular cartilage defect include: bone marrow-derived mesenchymal stem cells (MSCs), adipose-derived stem cells (ASCs) from nearby fat pads, synovial cells, and native chondrocytes. Of these cell types, ASCs and MSCs are being studied for their recruitment by controlled release of cytokines.

Objective: To devise a cartilage regeneration approach without cell transplantation.

Materials and Methods: Gelatin microspheres were fabricated using a water-in-oil emulsion technique and loaded with 100ng/mL stromal cell-derived factor-1 (SDF1), 300ng/mL transforming growth factor-b3 (TGFb3), or PBS. Four conditions were tested: TGFb3 alone, SDF1 alone, SDF1+TGFb3, and cytokine-free. Acellular scaffolds were fabricated with two separate but integrated layers consisting of a layer of cross-linked 4% (w/v) calcium alginate-containing microspheres and an underlying collagen sponge. Human bone marrow MSCs and human ASCs were isolated from adult donors and seeded in 6-well plates (100,000 cells per well). Each scaffold was placed in the center of the well. Scaffolds were harvested after 3 hours, 1 week, and 3 weeks, fixed in 10% formalin, embedded in paraffin, and sectioned. DAPI staining was used to assess the number of cells per scaffold section and toluidine blue to assess chondrogenesis. H&E staining was done as a confirmation of DAPI and to evaluate tissue morphology. Multivariate ANOVA and Bonferroni tests were used for statistical analysis ($p < .05$).

Results and Conclusions: A layer of glistening white tissue was visible in the collagen portion of the scaffolds following 3 weeks of cell homing. DAPI staining confirmed that both MSCs and ASCs were homed into the collagen scaffold. Delivery of combinatory SDF1 and TGFβ3 was most effective to recruit both ASCs and MSCs into scaffolds upon 3 week cell homing, generating significantly greater cell numbers than the other three conditions. SDF1+TGFβ3 homed twice as many MSCs as ASCs in 3 weeks. SDF-1 recruited significantly more ASCs by 1 and 3 weeks than TGFβ3 alone or cytokine-free. For the MSCs, only the SDF-1/TGF-β3 condition resulted in a significantly greater cell number than the other three conditions at 3 weeks. These results were confirmed with H&E staining. Toluidine blue revealed darker staining for TGFβ3 alone and SDF1+TGFβ3 conditions after 3 week cell homing. In contrast, there was minimal blue staining for cytokine-free or SDF1 alone conditions.

Discussion: We discovered that the SDF1/TGFβ3 delivery system not only homed stem/progenitor cells but also induced chondrogenesis of the homed cells *in vitro*. While SDF1 was able to home ASCs and MSCs, its action alone did not seem to be sufficient for inducing chondrogenesis. In contrast, TGFβ3 showed moderate cell homing effects but was capable of inducing MSC differentiation into chondrocytes. Combinatory delivery of SDF1 and TGFβ3 was the most effective in homing both ASCs and MSCs, in addition to generating cartilage matrix, as shown by toluidine blue staining. MSCs and ASCs may act synergistically *in vivo*. Future experimentation will address *in vivo* effects of cell homing and chondrogenesis, as well as other target cell lineages present in a cartilage defect, which include synovial cells and hematopoietic cells.

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Differentiating Dental Pulp Stem Cells to Insulin-Producing β Cells

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Introduction: Insulin-producing cells have previously been derived from embryonic stem cells as well as postnatal stem cells isolated from amniotic fluid, bone marrow, or adipose tissue. However, its application in the real world is limited by several challenges including cell source and insulin yield. In this study, we explored the possibility of using dental pulp stem cells to generate insulin-producing cells. Dental pulp is neural crest-derived mesenchymal tissue, and its formation relies on epithelial-mesenchymal interactions during development. There are several advantages to using dental pulp as the source of stem cells. Unlike embryonic stem cells, there is no ethical controversy surrounding dental pulp stem cells. Dental pulp stem cells can also be isolated using minimally invasive procedures as long as teeth are present.

Objective: Stem cells isolated from dental pulp have previously been demonstrated to express the embryonic stem cell markers Sox2, Nanog, and Oct4, suggesting their primitive status. The goal of this study is to differentiate dental pulp stem cells to insulin-producing cells and characterize the successful clones with respect to the cell markers that were previously demonstrated.

Materials and Methods: Deciduous incisors and permanent third molars were collected from several donors with IRB approval. The pulp was isolated and enzyme digested. Adherent cells were subsequently cultured in DMEM. Single cells in suspension were isolated from heterogeneous dental pulp stem cells and cultured under identical conditions. After 2 weeks, round colonies were isolated for further growth. Cell colonies were fixed using 10% formalin and stained with antibodies for Sox2, Nanog, and Oct4, as well as DAPI. Immunostained sections were then viewed using the fluorescent microscope. Real-time PCR was performed using the TaqMan kit and the primers and probes appropriate for the marker of interest. Cloned dental pulp stem cells were subjected to conditions to promote insulin-producing cell differentiation using a previously published 4-stage protocol. The cell line that showed the most amount of differentiation to insulin-producing cells, as quantified by the amount of insulin staining, was analyzed for 920 human stem cell genes by microarray. The upregulated genes in the differentiated cell line, compared to an undifferentiated cell line, were confirmed by immunohistochemistry.

Results and Conclusions: Most cells lines showed minimal insulin immunostaining indicating failure to differentiate. The cell line that showed a remarkable amount of insulin staining was dTSC-7, which indicates successful differentiation to insulin-producing cells. Differentiated dTSC-7 cells were also shown to express Pdx-1, a pancreas-specific transcription factor, which further confirms their successful differentiation. Thus, it was important to define the characteristics of this cell line that allowed it to undergo successful differentiation.

Microarray analysis indicated that several genes were upregulated compared to a cell line that failed to differentiate. These include nestin, N-CAM, NGF, BEX1/BEX2, PTTG, MEST, and SERPINF1. A positive immunostain of dTSC-7 clone for nestin confirms these results. Nestin is an intermediate filament protein expressed in neurons. N-CAM is a glycoprotein expressed on the surface of neurons. NGF (neural growth factor) is a signaling molecule critical for the survival and maintenance of neurons during development. BEX1 and BEX2 are markers specifically expressed in the brain. PTTG (pituitary tumor transforming gene) is a proto-oncogene expressed in neuroprogenitor cells. MEST (mesoderm specific transcript homolog) is expressed in early embryos. SERPINF1 (serpin peptidase inhibitor, clade F, member 1) is a neurotrophic protein that induces neuronal differentiation. Surprisingly, the most significantly upregulated genes in dTSC7 found through microarray analysis are important in neurons. This suggests a connection between neural differentiation and insulin-producing cell differentiation, possibly sharing several crucial transcription factors. The presence of key transcription factors may allow dental pulp stem cells to be manipulated away from the odontoblast lineage and towards other fates. Identification of such factors requires further work.

Discussion: Characterization of dental pulp stem cells capable of differentiating into insulin-producing cells is the first step to using these cells in cell replacement therapy for diabetics where endogenous insulin production is compromised.

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Odontoblastic Differentiation of Tooth-Derived Stem Cells Mediated by Cross-Talk with Oral Epithelial Cells

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Introduction: Odontoblasts are neural crest-derived, polarized cells located at the periphery of the dental pulp which secrete pre-dentin and dentin matrix, which forms the mineralized frameworks of teeth. Accordingly, odontoblasts are considered an essential cell source for tooth regeneration. Despite its wide implications in tooth development and regeneration, odontoblastic differentiation from stem/progenitor cells is not fully understood. Recently, it was demonstrated that tooth-derived stem cells (TSCs) isolated from the pulp of deciduous teeth can be differentiated into odontoblasts *in vivo*, in addition to mesenchymal lineages including osteoblasts, chondrocytes, and adipocytes. Here, we tested the hypothesis that the biochemical interaction with epithelial cells, which plays critical roles in odontoblastic differentiation of dental mesenchyme in development, can promote TSC differentiation into odontoblasts *in vitro*.

Objective: To derive odontoblasts from tooth stem cells.

Materials and Methods: Tooth-derived stem cells (TSCs) were isolated from pulps of 5- to 7-year-old deciduous teeth upon IRB approval. Briefly, normal exfoliated human deciduous teeth were collected, and the pulp tissue was gently separated from the crown and root. Upon washing briefly in PBS, the isolated pulp was digested in a solution of 3 mg/mL collagenase type I and 4 mg/mL dispase with gentle shaking for 1 hr at 37°C. The digest was filtered with a cell strainer (Falcon, mesh size 70 µm) followed by centrifugation at 500 rcf for 8 min. Cell suspensions were then culture-expanded in DMEM with 10% FBS and 1% antibiotics with fresh medium change every 2-3 days. Then P2-3 TSCs (5000 cells/well) were co-cultured with P3-4 human oral keratinocytes (5000 cells/well) using 24-well Transwell system with regular growth media or odontoblastic differentiation media supplemented with 50 µg/ml ascorbate, 10 mM β-glycerophosphate, and 0.1µM Dex. Upon 4 weeks co-culture, odontoblastic differentiation of TSCs was evaluated by mineral deposition and marker expression.

Results and Discussion: The present study showed initial evidence of odontoblastic differentiation of tooth-derived stem cells (TSCs) mediated by biochemical interactions with epithelial cells. It was demonstrated that calcium content, as an early marker of mineralization, was significantly increased when TSCs were co-cultured with oral keratinocytes in Transwell, in comparison with TSCs alone. Transwell membrane used in this study has pores of 3 µm which allows the transport of macromolecules, ions, small molecules, hormones, and growth factors but not cell migration. Thus, it is postulated that secreting factors by epithelial cells, whether induced by cross-talk with TSCs or not, may promote mineralization by stimulating odontoblastic differentiation of TSCs. Future study will evaluate additional markers for odontogenic differentiation including DMP and DSP for a prolonged duration of the co-culture with OIS treatment.

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Bioengineered Regeneration of Human and Rat Teeth *In Vivo*

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Introduction: Tooth loss in many species equates to the end of life. In humans, tooth loss is by far the primary task of dentistry and results from caries, periodontal disease, congenital anomalies, trauma, and tumor resection. Over 70 percent of the U.S. population is partially edentulous, including a fraction of the population that is completely edentulous. From documented evidence in the 16th century, attempts have been made to replace missing teeth. Contemporary dentistry restores missing teeth with dentures or dental implants. Despite high clinical success rates of dental implants, none of the current dental replacements remodels with the host tissue. Approximately one dental implant fails every hour nationwide. Recently, several experimental studies have shown that rudimentary tooth-like structures can be grown in animal models. However, none of the regenerated tooth-like structures has the anatomical shape and dimensions of human teeth. Furthermore, all tooth regeneration studies to date have relied on the delivery of cells, including dental stem cells. Clinically, it would be very difficult, if not impossible, to harvest dental stem cells from patients who lack a donor source. In the present study, we hypothesized that anatomically shaped and dimensioned human teeth can regenerate by bioactive cues and without cell delivery.

Objective: To regenerate anatomically shaped and dimensioned human and rat tooth-like structures with bioengineered tooth scaffolds encapsulating bioactive cues.

Materials and Methods: Human tooth scaffolds were fabricated in 3-D by reconstruction of patient-specific tooth form followed by rapid prototyping with layer deposition. A hybrid of ϵ -polycaprolactone and hydroxyapatite (PCL-HA) was co-melt and bioplotted into anatomically shaped tooth scaffolds with internal interconnecting microchannels (200 μ m diameter) and infused with bone morphogenetic protein 7 (BMP7) and stromal cell-derived factor-1 (SDF1). In parallel, the mandibular central incisors of Sprague Dawley rats were also reconstructed in 3-D also by rapid prototyping. In each of 36 Sprague Dawley rats, BMP7- and SDF1- delivered human tooth scaffolds were implanted in the dorsum, whereas BMP7- and SDF1- delivered rat mandibular incisor scaffolds were implanted to replace native mandibular incisors that had been surgically extracted, followed by primary closure of the gingival flap. Control human and rat tooth scaffolds contained no growth factors. All implanted tooth scaffolds were harvested 5 weeks post-implantation and histologically evaluated for angiogenesis and tissue ingrowth.

Results and Discussion: Anatomically shaped and dimensioned human tooth-like structures regenerated in the dorsum of Sprague-Dawley rats. Microscopic sections reveal the presence of angiogenesis and tissue ingrowth into microchannels of rapid prototyped scaffolds. In parallel, rat teeth regenerated in the sockets of lower central incisors in Sprague-Dawley rats and integrated with periodontal tissue. A highly cellular zone was formed uniformly surrounding the rapid prototyped scaffolds that are reminiscent of periodontal ligament although cellular reduction and collagenous matrix synthesis is required for further development. The specimens from the extraction sockets seemingly exhibit more apparent cellular infiltration and connective tissue ingrowth while the specimens harvested from the dorsum sites tend to show more angiogenesis. These findings represent the first discovery that human shaped and dimensioned tooth-like structures can regenerate *in vivo*, yielding the possibility of regeneration of entire human teeth in patients especially without cell delivery.

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Evaluation of a Hydrogel-Based Scaffold for Dental Pulp Regeneration

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Introduction: Root canal therapy used to treat carious infections usually requires the removal of the entire pulpal tissue, resulting in a devitalized tooth. A more progressive treatment would be to promote pulpal healing and regeneration. To this end, the goal of this study is to evaluate the potential of a novel polyethylene glycol (PEG) hydrogel-based scaffold for pulp regeneration. PEG-fibrinogen is a hydrogel which consists of a network of synthetic and biologic building blocks that could enhance tissue compatibility with control over its structural properties¹. It has also been shown to be highly efficacious for promoting bone healing². Additional advantages include the UV-based polymerization process which could be easily incorporated into dental practices.

Objective: To evaluate the potential of PEG-fibrinogen hydrogel as a viable scaffold supporting the proliferation and maturation of dental pulp cells.

Materials and Methods:

- Cells/Cell Culture: Dental pulp cells were isolated via enzymatic digestion from extracted healthy human teeth. All cultures were maintained in fully supplemented media with 50µg/mL ascorbic acid.
- PEG-F gels: The hydrogel was prepared by mixing PEG-Fibrinogen and PEG-DA to achieve a final polymer concentration of 30mg/ml. Igracure Photoinitiator solution was added, and the gel was cured under UV light (365nm).
- Study design: Human dental pulp cells were mixed into the gel (160,000cells/gel) and, after polymerization, cultured in fully supplemented media with 50µg/mL ascorbic acid. A monolayer culture of pulp cells served as control.
- Endpoint Analyses: Cell viability (n=2) was visualized by LIVE/DEAD assay while proliferation (n=5) was quantified using the PicoGreen Assay. Additionally, alkaline phosphatase (ALP) activity (n=5) was measured using an enzymatic conversion assay, and collagen deposition (n=2) was determined by histological staining with H&E and Picosirius Red. Statistical analysis was performed using multi-way ANOVA, and statistical significance was attained at p<0.05.

Results and Discussion: LIVE/DEAD assay demonstrated viable pulp cells in the PEG-based hydrogel. In addition, while cells were initially spherical in the gel, they exhibited an elongated morphology beginning at Day 7. No significant change in cell number was observed when cultured in the PEG hydrogel while cell proliferation significantly increased in the monolayer control over time (p<0.05). These observations are similar to those reported for cells cultured in hydrogel-based matrices³. It was also observed that the ALP activity of pulp cells increased over time in the hydrogel beginning at Day 7. Picosirius Red staining revealed greater deposition of collagen within the hydrogel compared to monolayer controls.

Conclusion: The results observed in this study demonstrate that PEG-Fibrinogen hydrogel supported pulp cell viability and physiologically relevant morphology. Moreover, in addition to positive ALP activity, a collagen-like matrix was produced in the hydrogel. Future studies will focus on scaffold optimization for dental pulp regeneration.

References: ¹Dikovsky et al. *Biomaterials*. 2006;27(8):1496-506. ²Peled et al. *J Biomed Mater Res A*. 2007;80(4):874-84. ³Mauck et al. *Osteoarthritis Cartilage*. 2006;14(2):179-89.

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***In Vitro* Pulp Cell Growth and Differentiation in Alginate Hydrogel Matrix**

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Introduction: Although current approaches of therapy of pulpal inflammation and injury have high success rates, in an ideal type of therapy, injured or necrotic pulp would be removed and replaced with healthy pulp tissue to achieve tooth revitalization. Potential techniques of regenerative endodontics include a) revascularization of the root canal via blood clotting, b) stem cell therapy, c) pulp implant, d) scaffold implant, e) 3-D cell printing, f) injectable scaffolds, and g) gene therapy¹. The long-term research goal of the lab is to develop a solution for pulp regeneration that would allow the remaining pulp tissue (in the case of pulpotomy) or implanted pulp cells (in the case of pulpectomy, necrotic pulp, or retreatment) to refill the pulp chamber. A more immediate goal is to develop a scaffold that supports pulp cell growth and differentiation and promotes vascularization.

Objective: To determine whether alginate hydrogel seeded with pulp cells and injected into cleaned pulp cavity of human teeth will support growth and differentiation of these cells.

Materials and Methods: Thirty-six autoclaved human teeth with cleaned and shaped pulp cavities were used. The experimental group consisted of pulp cells embedded in alginate gel and injected into pulp cavity while the control group included alginate hydrogel with pulp cells outside the pulp cavity and teeth injected with acellular alginate. 4% medium viscosity alginate hydrogel was mixed with equal volume of pulp cells (previously isolated by digestion method in the lab; only cells below passage four were used in the study) in media to obtain cell density of 1.0×10^6 cells/mL. The teeth were injected, with a syringe, with the seeded hydrogel (average volume 0.1 mL) while the apex of the tooth was submerged about 1mm into 0.1 M CaCl₂ to prevent excessive leakage of the gel. The hydrogel was allowed to crosslink by soaking in 0.1 M CaCl₂ at 37°C for 30 min while the solution was agitated. The teeth were cultured in well-plates, one tooth per well, in fully supplemented DMEM + 10% FBS with 2% penicillin (10,000 IU) – streptomycin solution (10 mg/ml) and 5.0 µg/ml of Amphotericin at 37 °C and 5% CO₂; media was changed every other day. Cellular growth, morphology, and differentiation was assessed on days 0, 1, 3, 7, 14, 21. Cell proliferation was quantified using total DNA assay (PicoGreen® dsDNA) and LIVE/DEAD® assay. For cell differentiation, standard assays were used to analyze alkaline phosphatase (ALP) activity, glycosaminoglycan (GAG) content, and total collagen production. Cell morphology was examined through histochemical staining (H&E).

Preliminary experiments: Only preliminary experiments have been done so far. In theory, alginate hydrogel is expected to support cell proliferation and viability. As to the cellular morphology, different types of hydrogel are observed in our laboratory to give rise to distinct morphological changes ranging from more physiologically elongated spindle-shaped to spherical cells. Another criterion that would render alginate hydrogel an optimal scaffold would be matrix synthesis as exemplified by ALP activity and total GAG and collagen production.

Discussion: Easy delivery is one of the advantages of alginate hydrogel for pulp regeneration. If vital pulp remains, it can be used as source of progenitor cells, and only acellular scaffold of hydrogel + growth factors + antibiotic, etc. will be injected. In the situation when entire pulp is removed, the tissue construct will consist of an apical layer of 1-3 mm of hydrogel + cells + growth factors + antibiotics, etc. with the remaining pulp chamber filled with acellular scaffold.

References: ¹Murray PE, Garcia-Godoy F, Hargreaves KM. Regenerative endodontics: a review of current status and a call for action. *J of Endo.* 2007; 33(4):377-390.

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Stem Cell Based Soft Tissue Grafts for Plastic and Reconstructive Surgeries

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Introduction: Soft tissue defects resulting from deep burns, traumatic injury, tumor resection, and congenital defects need an immediate attention. Each year, several plastic and reconstructive surgical procedures are performed to repair such soft tissue defects. The most common procedure to fill up these defects has been autologous fat tissue grafting. When autologous fat tissue is transplanted from one location to the defect site, there is a significant resorption of the transplanted tissue over time. The lack of sufficient revascularization of the transplanted tissue results in 40-60% of the graft volume loss. This insufficient tissue vascularization limits the supply of oxygen and nutrients to the tissue, limiting the chance for long term tissue viability. Tissue engineering strategies are thus being investigated to develop methods for generating vascularized adipose tissue to sustain the shape and size of the implanted graft.

Objectives: 1) To study the effect of HSC conditioned medium (HSC-CM) on human mesenchymal stem cells (hMSCs) differentiating into adipocytes and 2) to study the effect of Epidermal Growth factor (EGF) protein inhibitor MEK1 Inhibitor and Secretase Gamma on adipogenic differentiation of hMSCs.

Materials and Methods: Human adipose derived stem cells (hADSCs) were differentiated using adipogenic inducing medium based on our previous methods for 2 and 4 weeks¹. CD34+ Hematopoietic stem cells (HSCs) were commercially purchased from ATCC. The adipocytes were identified using Oil red O lipid stain (Sigma) and were quantified by measuring glycerol and leptin content. HSC-CM was collected after spinning the HSCs growing in HSC culture medium for about 3 days.

Results: To assess the effect of HSCs on human MSC differentiation, hMSCs were co-cultured with HSC conditioned medium (HSC-CM) and adipogenic medium. There was no significant difference in the amount of fat deposition as compared to hMSCs exposed to adipogenic medium. The addition of MEK1 Inhibitor and Secretase-Gamma Inhibitor to the HSC culture, prior to adipogenic induction of hMSCs, led to significant amount of fat deposition as compared to hMSCs exposed to adipogenic medium and hMSCs exposed to HSC-CM and adipogenic medium.

Discussion: HSC-CM does not have an effect on hMSC differentiation capacity. Based on our previous experience, co-transplantation of HSCs with hMSCs/progenitor cells improves the regeneration of vascularized graft since HSCs have the ability to home the blood vessels forming cells². Adipogenesis can be further accelerated using EGF potent inhibitors. The next step would be to perform these experiments *in vivo*.

References: ¹Alhadlaq A, Tang M, Mao JJ. Engineered adipose tissue from human mesenchymal stem cells maintains predefined shape and dimension: implications in soft tissue augmentation and reconstruction. *Tissue Eng* 2005;11:556-566.

²Moioli EK, Clark PA, Chen M, Dennis JE, Erickson HP, Gerson SL, Mao JJ. Synergistic actions of hematopoietic and mesenchymal stem/progenitor cells in vascularizing bioengineered tissues. *PLoS ONE*. 2008;3(12):e3922. Epub 2008 Dec 15.

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Dental Stem Cell Differentiation into Myoblast-like Cells and Engraftment in Skeletal Muscle

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Introduction: Dental stem cells (DSCs) were first discovered when cells isolated from dental pulp were found to undergo multiple population doublings and differentiation into odontoblast-like cells. Because DSCs are derived from neural crest cells, they have been induced to express a number of neural and glial markers such as nestin, β -tubulin, PSA-CAM, NF-M, and NF-H. In addition to the multi-lineage differentiation potential, DSCs also highly express embryonic stem cells markers Oct-4, Sox2, and Nanog at early passages, suggesting DSCs' stemness and versatility. However, there is no reported evidence to date that DSCs can be differentiated into myoblast-like cells.

Objective: To differentiate dental stem cells into myoblast-like cells.

Materials and Methods: Specimens used for the experiments included deciduous teeth and permanent teeth from Columbia University College of Dental Medicine under IRB approval. Dental pulp stem cells were isolated. The p0 DSCs were diluted into 1cell/300 μ L medium. The cells were seeded in 96 well plates with 100 μ L/well medium. Single colonies were isolated and expanded. *In vitro* myogenic differentiation was performed in a special myogenic cocktail containing 5% horse serum. Myogenesis was examined by cell morphology and marker gene expression (myosin heavy chain, MyoD, and Myf5). The positive clones were inoculated *in vivo* in dystrophied mice for skeletal muscle regeneration. Briefly, cardiotoxin was injected into the tibialis anterior (TA) muscle of SCID mice followed by delivery of DSC clones (1 million cells). Muscle regeneration was examined by human nuclear staining and the expression of human dystrophin. DSC clones were labeled with bioconjugated quantum dots (QDs) per our previous approaches (Shah et al., 2007).

Results and Conclusions: Two out of the 50 DSC clones differentiated into multi-nucleated and elongated cells with high yield and became positive to myosin heavy chain (MHC) antibody staining. These multi-nucleated, MHC-positive cells are considered DSC-derived myoblast-like cells. In the paralyzed TA muscles, the engrafted human DSCs showed positive expression of dystrophin, a structural muscle protein that is absent in Duchenne Muscular Dystrophy (DMD). These data demonstrate that DSCs are capable of differentiation into myoblast-like cells and can be engrafted into paralyzed skeletal muscle, suggesting that DSCs may participate in the healing of injured muscle fibers.

Discussion: We demonstrate for the first time transformation of dental pulp stem cells into myoblast-like cells *in vitro* and also engraftment of DSCs into paralyzed skeletal muscle. These findings provide the proof of concept that dental stem cells may participate in the healing of injured skeletal muscles in both craniofacial and appendicular skeletal systems. Ongoing research is focusing on the efficacy of regeneration and participation by DSCs. We also plan to identify additional subpopulation of these DSCs that are prone to myogenic differentiation.

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Dental Care Access for Elderly Patients on Medicaid

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Introduction: Oral health and healthcare is an important, but often neglected, aspect of healthcare for the elderly, especially functionally dependent elderly receiving homecare. Not only is this population at increased risk of dental disease, but morbidity is heightened due to the effects of medications and functional disability. It is therefore important that older adults, especially minority, disadvantaged, and homebound seniors, receive optimal daily and professional dental care. However, access to and utilization of dental services is problematic due to functional disabilities, medical co-morbidities, and language, transportation, and insurance barriers, and homecare service providers are often unaware of the locations and types of services provided by dental providers. This work was undertaken as part of a larger study designed to improve daily and professional dental care services for older adults receiving homecare services in New York City and was conducted in collaboration with Isabella Homecare (Isabella).

Objective: To develop, test, and distribute location-specific dental treatment resource lists, dental care informational sheets, and Medicaid Dental regulations informational sheets for homecare providers and their clients in New York City. These materials were developed in order to facilitate daily and professional dental care among older adults receiving homecare services.

Materials and Methods: A series of focus groups with nurses and home health aides (N = 21) were conducted to assess dental care knowledge and needs. These groups indicated that homecare workers are unaware of Medicaid Dental regulations and/or the locations of Medicaid dental practices. Isabella provided a list of zip codes constituting its service areas in NYC. Dental practices in each zip code were located through Yellow Pages online and a map search. Each of the practices was contacted via telephone, and practice characteristics (name of dentist and receptionist, contact information, Medicaid acceptance, wheelchair access, ability to treat in a wheelchair, and languages spoken) were recorded. The data were entered into an Excel spreadsheet. Zip codes were stratified into broad geographic areas, and highly accessible practices were mapped by geographic area. A booklet describing Medicaid Dental regulations was also created for nurses. A second focus group with nurses and key informant interviews was conducted to determine perceived utility of the materials.

Results and Conclusions: The zip code list of Isabella's service area included 37 zip codes (10021 to 10474); 597 discrete dental practices were located within the service area. A total of 248 practices accepted Medicaid; of these, 230 (93%) had bilingual providers, 141 (57%) were wheelchair accessible, and 61 (25%) were able to provide wheelchair dental services. A final list of "client friendly" practices by zip code was developed (n = 74). Focus groups and key informant interviews suggest that perceived utility of the materials was high.

Discussion: Insurance, payment issues, and/or wheelchair access are primary barriers to professional dental care among older adults. Contacting dental providers proved to be tedious and timely, and surprisingly many offices were reluctant or even unwilling to provide information. This equates to patients possibly making numerous phone calls without any guarantee of finding a dentist that can adequately accommodate them. We therefore anticipate that the dental resource list and maps will be valuable resources for patients on Medicaid, and preliminary data suggest that they were well received. Without these resources, many older adults might forego dental treatment by a dental professional.

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Assessment of Pre-Doctoral Pediatric Dentistry Education in US Dental Schools

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Introduction and Objective: To assess pre-doctoral pediatric dentistry education and curriculum needs in US dental schools, including didactic and clinical hours, faculty-student ratios, curriculum content, and competency testing.

Methods: A questionnaire was designed and mailed to all fifty-seven pre-doctoral pediatric dentistry program directors in the United States. The survey design included ten multiple-choice questions with comment sections for all program directors. Participation was anonymous, and responses were collected using an online service. Reminders were sent periodically for four months after which polling closed. Twenty-six program directors from US dental schools responded to the survey.

Results: The reported data indicated that the majority (76.9%) of directors identified special needs care as the number one “gap” in essential pediatric clinical experiences at the pre-doctoral level. Emergency care (65.4%) and infant oral health (61.5%) were also perceived as areas of weakness in pre-doctoral pediatric dentistry clinical experiences. Significant variations in curriculum hours, content, and competency testing were also noted in this sample.

Conclusions: The results point to deficiencies in essential clinical experiences in pre-doctoral pediatric dentistry in US dental schools. The American Academy of Pediatric Dentistry provides a list of “integral experiences” for pre-doctoral students that can serve as a guide for program directors. Results from this survey provide national averages which may be helpful in assessing the individual needs of dental schools. More data is warranted to better understand and standardize curriculum requirements in pre-doctoral pediatric dental programs.

Policy Statements Concerning the Oral Health Care Needs of Older Americans: A Vision for the Future

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Introduction: According to the U.S. Census Bureau, the United States population today is over 300 million and it is estimated that 12.4% of the population are 65 years of age and older. It is projected that by the year 2050 the U.S. population will reach 400 million people and 20% will be 65 and older. While the population in general and the number of people 65 and older is increasing, the dentist to population ratio is declining. Demographic changes elicit many questions and concerns about oral health for adults including: Will there be an increase in oral disease with age? How does this demographic shift change the demand for oral care? The future holds the challenge of providing appropriate oral health care for the elderly, a population that will present with medical co-morbidities, complex social needs and limited means to afford required dental services.

Objective: To compile information from major reports and policy documents regarding the oral health needs of seniors in the U.S. This information can assist advocacy efforts and help the profession prepare for the future needs of this vulnerable population.

Materials and Methods: Information was obtained from published national reports including Dental Education at the Crossroads: Challenges and Change, The Surgeon General Report, The Future of Dentistry, Healthy People 2010 and Retooling for Aging America: Building a Health Care Workforce.

Results: The following trends were identified from the published national reports. The demand for dental care among people 65 and older will increase as a result of the absolute and relative increase in size of this cohort and the retention of teeth by older adults. In addition, there is a lack of geriatric dental academicians and dental practitioners with training in geriatric dentistry. Today, all dental schools have incorporated some geriatric dentistry training into their curriculum, yet the majority of students still feel ill-prepared to treat elderly patients upon graduating from dental school. The national reports indicate that oral health care utilization by the elderly is significantly less frequent than oral health care utilization among young and middle aged adults. Lack of utilization of dental health care services can be explained by a lack of access to care. In addition, many older Americans lose their dental insurance upon retirement and cannot afford to pay for dental care since Medicare does not provide coverage for routine dental services. Older individuals suffer from other health problems that complicate dental care and create additional obstacles. Thus, there are more barriers to oral and dental care among the geriatric population than among the young and middle age population.

Conclusion: In a step towards the future, the American Dental Association passed “Resolution 5H 2006,” which was intended to address the oral health care issues of vulnerable elders. Results from this literature review support ADA Resolution 5H 2006. Since oral health is an integral part of general health, dentistry must consider the development of a comprehensive plan to provide oral health services to older adults. Training of dentists and dental hygienists must emphasize the dental needs of older adults. In addition, health care providers should stress to the elderly population the importance of continued routine dental care as one ages. Providing appropriate oral health care for older adults requires consideration of medical co-morbidities, polypharmacy, public health issues and social norms that impact the lives of seniors.

The Relationship between Country of Origin and Participation in the Obstetrics and Periodontal Therapy Phase II (OPT II) Study

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Introduction: The Obstetrics and Periodontal Therapy study recruited a diverse group of 823 women from March 2003 to June 2005 to study the effects of periodontal therapy on pre-term birth. Test sites were located in Mississippi, Minnesota, Kentucky, and Harlem Hospital in New York City. The trial concluded that non-surgical periodontal therapy is safe and effective during pregnancy but is not associated with improved birth outcomes. In a follow up study (OPT II), each test site successfully registered over 60% of the mothers from the OPT I cohort to investigate whether the pre-natal periodontal health status of OPT I mothers had any effect on the cognitive and psychomotor development of their children. Mothers and children were asked to attend two OPT II visits-- when the children were at 24 and 36 (+/- 2) months of age. The OPT II study was completed in February 2009 and results are pending.

Objective: Our study focused on the demographics of the OPT II participants at the Harlem Hospital site. Most participants enrolled at this site are either U.S.-born ethnic minorities or immigrants from Africa or Latin America. The poor representation of these groups in clinical research has been well documented with most of the literature focusing on African Americans and their general mistrust of clinical research. However, this legacy of mistrust may not affect participants whose country of origin is not the U.S. I conducted a retrospective review of the attendance of U.S.-born and foreign-born participants in both OPT II visits. I hypothesized that OPT II participants who were not born in the United States would be more likely to attend both of the OPT II visits.

Materials and Methods: Nationality was determined by self-reported status on the study intake form. Participants who attended at least one of the OPT II visits were classified as compliant, and those who failed to attend either visit were classified as non-compliant. The visit attendance of OPT II participants was analyzed using the cross-tabulation test in SPSS version 16.0. A two-sided chi-square test was used to assess significance ($p < 0.05$).

Results and Conclusions: Of the 185 OPT II participants at the Harlem Hospital site, 157 of the participant files contained complete data on country of origin and the number of OPT II visits attended. 77 participants identified their country of origin as the United States, and 80 identified their country of origin as outside of the U.S. Of the U.S.-born participants, 76.5% were self-identified African Americans. In terms of patient participation, 62 out of 157 participants were present for at least one OPT II visit. 32 out of 77 U.S.-born participants attended at least one OPT II visit while 30 out of 80 foreign-born participants attended at least one OPT II visit. After cross-tabulation analysis, no significant relationship was found between the visit attendance of U.S.-born and foreign-born mothers ($p = 0.603$).

Discussion: The reasons for attending or failing to attend an OPT II visit are limitless. OPT II provided mothers with a gift certificate for groceries or children's toys, and some normally non-compliant participants may have attended for that reason. Despite the availability of translators, language may also have been a barrier to the attendance of some foreign-born participants who are not native English speakers. The biggest limitation of this study was that participants either did not offer an explanation for their absence from an OPT II visit, or their reasons were not documented.

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Dental Caries among Disadvantaged Three to Four Year Old Children in Northern Manhattan between 2007 and 2008

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Introduction: Dental caries is a preventable disease, yet it remains the most common chronic disease in children (five times more prevalent than asthma). The National Health and Nutrition Examination Survey (NHANES) recorded a decline in untreated dental caries for primary teeth; however, in the most recent survey (1999-2004), there has been an increase in caries in primary teeth particularly among younger children. A previous study conducted in northern Manhattan (1995-1997) reported a higher level of untreated caries in 3-4 year olds in comparison to children with similar socioeconomic status (SES) in NHANES III (1988-1994).

Objectives: To determine the prevalence of early childhood caries among 3 to 4 year old children in a disadvantaged predominantly minority urban population.

Materials and Methods: A retrospective chart review (n=805) was conducted for children enrolled in Head Start or day care programs in northern Manhattan who were patients of the Columbia DentCare mobile dental van. The study included children 3 to 4 years of age upon the initial exam. All children were examined by the same dentist between 2007 and 2008. Data collected included the sex, date of birth, date of initial visit, decayed, missing, or filled surfaces per teeth, and location of service. The mean number of decayed teeth (dt), filled teeth (ft), decayed and filled teeth (dft), and the percentage of decayed over total decayed and filled teeth (%d/dft) were calculated for the entire sample and for a sub-sample of children with at least one decayed or filled tooth. Children were considered caries-free if dft=0. Data was analyzed in SPSS version 14.

Results: There were 50.4% males and 49.6% females (n=805) in the sample. 49.6% of the sample was caries-free. Mean dft was 1.97 overall and 3.89 for children with dft>0.

Thirty-three percent of the sample (n=266) was examined in the Washington Heights/Inwood locations, and 67% (n=539) examined at sites in Harlem. Location of the examination was significantly associated with caries-free rate (p=0.001). The percentage of children examined in the Washington Heights/Inwood locations that were caries-free was 58.3% compared to 45.3% examined in Harlem. The level of untreated decay (%d/dft) was 90.4% and 94.4% for children examined in Washington Heights/Inwood and Harlem, respectively. Children examined in the Washington Heights/Inwood locations had significantly lower dft rates when compared to children examined in the Harlem locations (p<0.001).

The overall amount of untreated decay (%d/dft) was similar (93.28%) to the previous northern Manhattan chart review [(1995-1997) (91%)]. Mean dft rates were more than 100% higher than those recorded in the previous northern Manhattan chart review (1995-1997), which was 1.08.

Conclusions: Young children in northern Manhattan seen in the Columbia DentCare van were observed to have a high prevalence of dental caries upon initial examination. Most of the caries observed on initial examination was not treated. Fewer children were caries-free in Harlem than in Washington Heights/Inwood. The caries disease burden as measured by dft among 3 and 4 year old children has increased in the northern Manhattan Head Start and day care children; mean rates of decayed and filled teeth in this study were higher than the means reported in the northern Manhattan study (1995-1997).

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Age-Related Differences in Beliefs about Oral Health and Disease among Harlem Adults

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Introduction: Certain symptoms, viewed by dental professionals as symptomatic of oral disease, are viewed as normal and inevitable part of aging by members of certain underserved ethnic/racial groups in the U.S. These dental beliefs are potentially impacted by factors such as lack of education, lack of access to oral health care information, financial difficulties, limited access to dental facilities, and personal experiences. To explore in-depth the perceptions of oral health and disease held by an urban African-American population that had previously cited oral health as its most prevalent health care need, a study was conducted to investigate the symptoms and perceived causes and impacts of oral disease as viewed by adult residents living in Central Harlem.

Objective: 1) To systematize and understand in depth how adults in Central Harlem define and/or describe oral health and/or oral diseases with respect to characteristic symptoms, reasons for occurrence, and associated impact(s). 2) To identify which beliefs are most prevalent in this population. 3) To analyze and compare how three age groups: young (< 36 years), middle age (36-55 years), and older individuals (> 55 years) within this population view these aspects of oral health and oral disease.

Materials and Methods: Face-to-face taped interviews were conducted with 118 non-Hispanic Black/African Americans adults in Central Harlem who were obtained via a street-intercept recruitment process. All participants must have had an oral disease symptom within the past six months that lasted at least two days. After obtaining informed consent, the participants first answered a questionnaire containing structured socio-demographic information followed by an in-depth interview that was taped and transcribed. Interview transcripts were then qualitatively analyzed using content/thematic analysis. The prevalence of each resulting theme was compared across the three age groups using Pearson Chi-squares.

Results: Symptoms associated with Oral Disease. Bad breath (48%), bleeding gums (35%), and rotten teeth (36%) were the most commonly reported symptoms of oral disease among all participants. Significant age differences were observed amongst the participants. Younger participants were most likely to mention toothache as a symptom of oral disease compared to middle-aged and older participants (33% vs. 11%, 14%, respectively, $p=0.03$). Younger participants and older participants were least likely to mention tooth discoloration as a symptom of oral disease compared to middle-aged participants (7%, 3% vs. 23%, $p=0.03$). Causes of Oral Disease. “Not brushing” (76%), “not going to the dentist” (37%), and “not flossing” (35%) were the most frequently mentioned causes of oral disease among all participants. Older participants were least likely to mention “not brushing” as a cause of oral disease when compared with younger and middle-aged participants (62% vs. 85%, 79%, $p=0.10$). Older participants were most likely to report “not going to the dentist” as a cause of oral disease compared to the younger and middle-aged (55% vs. 32%, 30% $p=0.07$). Younger participants were least likely to mention eating sweets as a cause of oral disease compared to the middle- and older-aged groups (4% vs. 19%, 27% $p=0.06$). In contrast, younger participants were most likely to report “not brushing” as a cause of oral disease (59% vs. 31%, 17% $p=0.003$). Impact of Oral Disease. Finally, 39% of total participants reported that oral disease could impact systemic health and cause physical sickness. This belief did not differ by age group.

Discussion: Study findings suggest there are differences in regards to how differing age groups view symptoms, causes, and impacts of oral health and disease amongst the African-American population in Central Harlem. These findings call for more public health education focused on the importance of preventive dental care and the importance of seeking professional dental care. In addition, they indicate that educational and other oral health intervention efforts in the Harlem community can usefully be targeted and/or tailored to specific age groups.

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Dental Services at Harlem United: The Influence of Clients' Dental Fear

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Introduction: Harlem United Community AIDS Center (HU) is a community-based organization in New York City that provides comprehensive dental, medical, and supportive health care to over 3,500 clients annually. Most HU clients are HIV/AIDS positive; some have a history of substance abuse, homelessness, and mental illness, and most have a history of limited or no access to quality health care.

Objectives: In an earlier intake survey, reported at Birnberg 2008, new patients at the HU dental clinic identified “fear of the dentist and/or pain” as the most prevalent reason for not going to the dentist regularly. Building on this finding, the goal of the present study was 1) to describe new and established HU patients’ oral health-related habits, 2) to describe the extent of their dental fear and anxiety, 3) to identify and understand the relationship between their dental fear, perceived quality of oral health, and their patterns of dental services utilization, and 4) ultimately to use the results of this study, as warranted, to target the delivery of better dental care to HU dental clients.

Material and Method: Of 107 candidate dental patients, 103 English-speaking patients (response rate = 96%) were recruited and participated in the study while seated in the dental clinic’s waiting area. (Nine patients preferred to speak in Spanish and were not eligible to participate in this phase of the study). Two student research assistants interviewed the patients using a pre-coded questionnaire asking about their oral habits and perspective on their current health care status, reasons for their dental visit, past experiences in receiving dental care, and perception and definition of dental fear. Responses were entered into a computer-based data set and analyzed using SPSS. 15.0.

Results: Sample members were predominantly established patients (76%) at HU Dental Clinic; 17% of sample members were new patients. Seventy-five percent of the sample had been to the dentist within the past 6 months while 41% of the sample reported going to the dentist more than twice a year. Less than 10% reported the presence of pain while 22% stated their main reason for visiting the dentist was the presence of a problem/something bothering them. The reported level of dental fear was modest with 57% of participants reporting no fear of having dental work done. Extramural (45%) referral patients generally reported lower levels of fear relative to intramural (39%) referral patients. Mean level of fear of dental equipment (2.3 on a scale of 1-5) was the highest mean level of fear among the four types of dental fear identified using factor analysis: fear of the dental setting, fear of dental equipment, fear associated with anticipating the appointment, and presence of physiological signs of fear. In cross-tabular analyses, fear of dental work was most associated with dental service utilization and self-assessed status of oral health (OH) and OH quality of life. In multivariate analyses, the likelihood of having a dental visit within the past 6 months was significantly associated with level of fear of having dental work done, extent of the self-reported physiological sign “my heart beats faster”, and being a new patient.

Discussion: Our research indicates a high rate of dental service utilization within a sample largely composed of established HU patients. Despite their fear, as measured by their self-reported physiological response, the likelihood of these clients having received dental care within the past six months was high. We believe clients are supported in this effort by the holistic approach employed by HU in delivering comprehensive health care. The high percentage of HU clients who visit the dental clinic without pain, and the frequency with which they visit the clinic, further supports our claim. The high level of utilization of dental services also potentially serves as an indicator of the numerous dental needs of HIV/AIDS patients, since many utilize dental services for routine follow up visits, as well as a potential reflection of previous histories of limited access to, or lack of, oral health care.

Conclusion: Greater understanding of the role of dental fear can help frame future delivery of dental care at HU, bringing into focus consideration whether new programmatic initiatives are necessary to address the level and types of fear expressed.

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Dental Care at Harlem United: a Comparative Analysis on New and Established Patients

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Introduction: Harlem United Community AIDS Center (HU) is a New York City community-based organization that provides a unique multi-modality approach of comprehensive medical, dental, and supportive care to thousands of clients annually. The dental clinic at HU provides comprehensive quality dental care, seeing approximately 200 clients and managing 250-300 visits monthly. Most clients at HU are HIV/AIDS positive, of minority background, of lower socioeconomic status, and have histories of homelessness, mental illness, and substance abuse.

Objective: This study analyzes data from two different surveys that were both conducted at the HU dental clinic. Survey 1 focused exclusively on new patients at intake while Survey 2 focused on clients presenting at the dental clinic that included both new and established patients. Based on these two differing data sources, the primary aim of this study was to identify the salient differences between new patients (from Survey 1) and established patients (from Survey 2) at the HU dental clinic with respect to patterns of dental care utilization, oral hygiene habits, self-assessed oral health, and dental fear.

Materials and Methods: Two different study samples were compared.

- Survey 1: A survey of *new* patients. 654 self-administered surveys were collected within a five year span from 2003 to 2008. New patients at their initial visit to the HU dental clinic, who completed the written questionnaire as part of their registration forms, constituted the population for this survey. The thirteen-question survey contained inquiries on oral hygiene habits, smoking history, reasons for not seeing the dentist, and oral health quality of life.
- Survey 2: A sample primarily composed of *established* patients. Patient interviews (n=103) were conducted by research assistants in an eight-week period, from July to August 2008. English-speaking patients who presented at the HU dental clinic, either as established patients returning to HU for a scheduled follow up visit (75.7%, n= 78) or as new patients for an initial visit (16.5%, n= 17), were recruited for this sample. The approximately 50-question survey consisted of inquiries on oral hygiene habits, current oral health care status, reasons for the dental visit, past dental experiences, and dental fear.

The data subset of established patients from Survey 2 was contrasted with the Survey 1 data from new patients. Responses were analyzed using the statistical analysis program, SPSS. 15.0. The significance of the difference between two independent proportions was calculated for comparison between the two groups.

Results and Conclusion: *Dental care service utilization:* 36.4% of new patients went to the dentist in the last six months compared to 85.5% of the established group ($p < .001$). *Oral hygiene habits:* 17.4% of new patients floss their teeth daily while 34.2% of established patients floss one time a day or more ($p < .001$). *Smoking habits:* 53.7% of new patients currently smoke compared to 45.5% of the established group ($p = .17$). *Self-assessed oral health:* 37.7% of new patients thought their teeth and mouth were “not healthy” or “in pain” while 50.7% of established patients described the condition of their teeth as “fair” or “poor” ($p = .04$). *Dental pain:* 33.8% of new patients self-reported pain as their reason for last dental visit while 3.8% of established patients indicate current status of dental pain and 12.8% of established patients report “something wrong, bothering me” as main reason for current visit to dentist (33.8% vs. 12.8%, $p < .001$). *Dental fear:* 45.7% of new patients who reported not going to the dentist regularly stated that fear of the dentist/pain was a reason for not visiting the dentist regularly; 79.5% of established patients reported having no or little fear of getting dental work done.

Discussion: This study compares two groups of new and established patients in order to gain insight into the influence of HU dental care on HIV/AIDS patients. Data from Survey 1 of new patients at HU dental clinic indicates that many new HU dental patients have gone to the dentist irregularly in the past and perceive their teeth as unhealthy, have dental pain, and are fearful of the dentist. Data from Survey 2 indicates that the majority of established HU patients have a high rate of dental care utilization and relatively low levels of dental fear and dental pain while self-assessing the condition of their teeth as fair or poor. These findings suggest that HIV/AIDS positive patients have a large need for dental care but have had limited access to dental care prior to becoming clients at HU. Findings from this study may be used as a basis for conducting an outcomes assessment study of HU dental services in order to help frame future dental care delivery.

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Current Status of Tobacco Cessation Education in U.S. Dental Schools

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Introduction: Tobacco use is a primary risk factor for many oral diseases including oral cancer, periodontitis, and delayed wound healing. Dentists are in a unique position to motivate and assist their patients to quit smoking and using smokeless tobacco. The repeated nature of dental treatment provides multiple opportunities for information, advice, and brief counseling. However, most dentists in practice report lack of training in effective tobacco cessation skills as a significant barrier to incorporating these behaviors into routine care. The last comprehensive survey of tobacco cessation in dental schools was conducted in 1999; in that survey, Barker and Williams found that only 11 dental schools have included formal tobacco cessation activities into their curriculum. A 2001 survey conducted by the American Dental Education Association (ADEA) found that there were no standardized curricula for tobacco cessation-related education in dental schools.

Objective: To examine current tobacco cessation curricula within United States dental schools (n=56).

Materials and Methods: In order to assess the current state of tobacco cessation education, surveys were administered to faculty identified as responsible for teaching tobacco cessation material. The questions examined course content and methods used to deliver course material and evaluated the efficacy of tobacco cessation education. The respondents also provided information on their perceived barriers to implementing tobacco cessation into the curriculum. Respondents were identified via school websites and phone calls to the office of the academic dean and then were contacted by means of electronic mail. Survey responses were collected via two methods: Survey Monkey (an online survey collection tool) or by telephone.

Results and Conclusions: Responses were received from 55 (98%) schools. Almost 48 (87%) of respondents reported that tobacco related education was an integrated part of their school's curriculum for pre-doctoral students; however, only 21 (38%) schools have a specific tobacco cessation/treatment of tobacco dependence course. Tobacco education was most likely to be incorporated into courses such as oral pathology/oral medicine (n=38.69%) and periodontics (n=35.64%). Pathologists were the most common provider of tobacco cessation material (n=31.56%) followed by periodontists (n=19.35%), general dentists (n=18.33%), psychologists (n=11.20%), and dental hygienists (n=11.20%). Fifty-two (96%) schools used traditional full class lectures to teach tobacco cessation while 14 (26%) reported using information technology such as DVDs. Only seven (13%) provided clinical clerkships in tobacco cessation. Seventeen (31%) respondents reported that lack of support was a barrier to implementing tobacco cessation within the curriculum. Of the 17 schools that identified lack of support as a barrier, 88.2% reported that dental hygienists were involved in tobacco cessation education compared to almost 46% of the 37 schools that do not consider lack of support a barrier to tobacco cessation integration into the curriculum (p=0.009).

Discussion: We found varied approaches to teaching tobacco cessation across dental schools. Improvements in dissemination and teaching of material and additional exposure via the clinical experience are needed within U.S. dental schools.

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Oral manifestations as related to HIV staging in Ethiopian patients An experiential report

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Introduction: In the summer of 2008, I traveled to Ethiopia on a fellowship sponsored by the International Center for AIDS Care and Treatment Program (ICAP) at Columbia University's Mailman School of Public Health. ICAP currently works in 14 countries, 13 of which are in sub-Saharan Africa, building family-focused HIV/AIDS prevention, care, and treatment programs. I was a member of the first group of students in the fellowship program, and the first dental professional sent to Africa as part of the ICAP program.

Objective: I taught dental clinicians how to recognize oral manifestations of HIV and assisted medical clinicians in the proper examination of the oral cavity. Oral lesions are an early indication of HIV infection and individuals with these lesions tend to be at greater risk for developing full blown AIDS as compared to patients without oral manifestations. Additionally, for those using highly active antiretroviral therapy (HAART), the presence of candidiasis and/or oral hairy leukoplakia is an indication of a drug regimen that is failing.

The World Health Organization published a paper in 1993 entitled, "A Guide for Epidemiological Studies of Oral Manifestations of HIV Infection" which advocated for further global research on oral manifestations of HIV and stated that "comprehensive descriptions of the global spectrum of oral manifestations of HIV infection will come only from research in the greatest possible number of countries and cultures." This experiential report attempts to address that charge by evaluating the assessment of oral manifestations of HIV infected patients in the Oromia Region of Ethiopia.

Materials and Methods: This project included two parts. The first was an evaluation of the thoroughness of oral exams performed by medical doctors and HIV/AIDS nurse specialists (HANS officers) in ICAP clinics in Ethiopia. HANS officers are nurses with advanced training in HIV and AIDS as related to diagnosis, prevention, treatment, and direct care.

The second phase was reviewing patient's charts in the HIV hospital clinics of Adama, Bishoftu, and Wolliso – locations within 140 kilometers of Addis Ababa, the capital of Ethiopia. The patients' CD4 count at presentation, HIV stage and clinical findings on the basis for staging were tallied. Ethiopian clinicians staged patients based on a presumptive clinical diagnosis where the HIV stage is diagnosed clinically rather than with sophisticated laboratory studies, i.e., a definitive diagnosis.

Conclusion: Both medical doctors and HANS officers did not routinely examine the oral cavity of HIV patients. If an oral exam was performed, it consisted of viewing the dorsum of the tongue. However, upon chart review, it was noted that oral lesions were the second most common manifestation of HIV after tuberculosis. The disparity between the low frequency of oral exams and the reported prevalence of oral manifestations of HIV infection suggests the need for standardization of the oral exam procedure for these patients. Evaluating the entire oral cavity, rather than solely viewing the extruded tongue, can result in the identification of additional oral manifestations of HIV.

It can be argued that if oral lesions are detected early in the history of the disease, patients can be started on HAART earlier and will have a better clinical outcome. It is imperative that physicians evaluating HIV lesions be properly trained in the examination of the oral cavity and identification of HIV associated oral lesions. This is of particular importance in developing countries where sophisticated diagnostic tests for HIV infection are not always available, and the prevalence of HIV infection is high.

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Cost-Effectiveness of Coronary Heart Disease Risk Assessment in a Dental Setting

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Introduction: Coronary heart disease (CHD) is a leading cause of death and debilitation in the United States. The prevalence of CHD in 2004 is estimated to be 15,800,000, and 700,000 new coronary attacks are predicted to occur annually. The direct and indirect cost of CHD totals \$151.6 billion. Primary prevention, avoiding the first CHD event, is an important strategy to reduce the mortality and healthcare costs of CHD. The Framingham risk score (FRS) is used to assess the risk for having a first CHD event within the next 10 years. CHD risk factors used to calculate the FRS include medical history, total and low density lipoprotein cholesterol levels, hemoglobin A1c, and blood pressure. Patients identified with a high FRS can start medication regimens and lifestyle modifications to control risk factors and lower their risk of a CHD event.

Greenberg et al. identified a large group of Americans who were at increased risk for a CHD event, unaware of their status, and saw an oral health care provider (OHCP) more regularly than a physician. This cohort is most likely to benefit from chairside screening of CHD risk because earlier identification of high CHD risk allows for earlier initiation of prevention activities that lower risk and facilitate avoidance of CHD events.

Objective: While previous studies identified a potential benefit in chairside screening for CHD risk by OHCPs, this study looked at whether or not it is cost-effective to do so.

Methods: A decision tree model was constructed to predict the possible events following a dental visit by a patient who was male, aged 40 to 85 years old with no CHD and no known specific CHD risk factors, and did not see a physician in the last year but did see an OHCP. The decision node was split into a screening arm and non-screening arm. In the screening arm, the OHCP took a FRS, and patients at intermediate or high risk were referred to a physician for confirmation of risk status and prescription of an intervention. In the non-screening arm, the FRS was taken if the patient ever visited a physician. The model had 6 possible endpoints: a CHD event, no CHD event, or initiation of one of four CHD risk reduction therapies. The model was run with both cost and life expectancy data to calculate the cost and life expectancy associated with each arm of the tree.

Results and Conclusions: The incremental cost effectiveness ratio (ICER), which compares the cost per quality-adjusted life year (QALY) between CHD risk screening by both OHCPs and physicians and screening by physicians alone, is \$1,657 per QALY.

Discussion: CHD risk assessment by an OHCP represents an additional step in CHD screening. Given that the ICER between CHD risk screening by physicians only and no screening at all is \$130,320 per QALY, the additional cost of \$1,657 per QALY is insignificant. The largest barrier to CHD risk screening in a dental setting may be the willingness of dentists to do so since the number of patients for which screening is appropriate is relatively small and a practice may expect to screen only 15 patients a year.

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Assessing Pulp Chamber Size and Root Canal Space as a Diagnostic Tool in Performing Root Canal Treatment

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Introduction: Pulp chamber size, anatomic configuration, and root canal space are important factors to be considered in the selection of teeth to be treated endodontically. Changes over time in pulp chamber size vary from young to the older individuals. The pulp ages gradually, accelerated by caries, trauma, periodontal disease, and iatrogenic procedures. The calcification process associated with aging appears clinically to be of a more linear type than what occurs in a younger tooth. Radiographic examination of the shape, size, amount of pulp tissue present, and measurement of the coronal pulp space can be used as a diagnostic tool in performing root canal treatment. Using these variables, three types of pulp chamber space can be classified: Class I - full pulp chamber, Class II - moderate reduction of pulp chamber, and Class III - severe reduction or no pulp chamber space. Assessing the reduced pulp chamber size and root canal space assists the dentist in determining the degree of difficulty to be encountered in performing root canal therapy.

Materials and Methods: Forty-two extracted human mandibular molar teeth were randomly selected and mounted on a baseplate wax strip and radiographed at two angles to view the pulp chamber sizes as well as the root canal space. Radiographs were placed on viewboxes and measured from the furcation upwards to the pulp chamber, occlusal downward to the pulp chamber, outer mesial wall of the tooth to the mesial wall of pulp chamber, outer distal wall of the tooth to the distal wall of pulp chamber, and height of pulp chamber. To measure the degree of calcification in the roots, measurements were taken of the mesial root only. These measurements were taken from outer wall of the mesial root to the root canal space at mid root level.

Results: Twenty-nine teeth were categorized as class I, 8 as class II, and 5 as class III after measurements of the forty-two extracted teeth. There were great differences in comparing the measurements of those teeth in Class I with those in Class III.

Conclusions: There was enough variance in the specimens to support a classification system of pulp chamber size and evaluation of parallel narrowing of the root canal space. Pulp chamber size classification can be used to establish a protocol which will assist in diagnosis, evaluation of treatment, and referral of difficult class III cases to specialists. Full and moderate pulp volumes, in Class I and II, respectively, can be inferred to be better sources of stem cell donor sites than those in Class III.

The Use of the Endoscope in Treating Recessed Pulp Chambers with Calcified Canals

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Introduction: Compromised circulation causes changes to pulp morphology. These circulatory changes are due to variable factors such as trauma, aging, large caries, bruxism, and iatrogenic dentistry and can result in the tooth having “geriatric changes” such as a recessed pulp chamber and calcification of the canal spaces. Success in root canal therapy depends on the ability to locate orifices and instrument canal spaces; teeth having geriatric changes are known to have lower success rates than teeth without geriatric changes. Therefore, adjunct techniques may aid in treating geriatrically involved teeth. The endoscope has been shown to be one of the best sources of magnification in endodontics, but little research has been done evaluating its use in the access and preparation of a root canal.

Objective: To evaluate the efficacy of the endoscope as an adjunct in treating recessed pulp chambers with calcified canals. The control group was the number of canals found by the naked eye and explorer. The experimental group was the number of canals found only with the use of the endoscope.

Materials and Methods: 246 extracted human molars were evaluated by taking radiographs of groups of three molars placed in red boxing wax in a buccal-lingual position and exposed at 70k/6ma for .25 seconds using a rectangular collimator 1-2 inches away from the specimen. Each film was evaluated by one student and the faculty mentor and visually classified as Class I, II, or III. Class I molars were distinguished by having a full pulp chamber, Class II had a modified pulp chamber, and Class III had a recessed pulp chamber. 43 molars were determined to be Class III and were used for the experiment. Access cavity preparations were made on the 43 Class III molars using #4 round bur in morphology preparations. The roof of the chamber was removed, and the floor of the chamber was evaluated with an explorer, light, and ultrasonic scaler. Afterwards, a MAHE International endoscope and digital single chip CCD camera was used to locate any orifices not found with the explorer. The endoscope’s screen revealed the location of orifices as dark circular areas and also showed dark connecting lines between orifices.

Results: 126 canals were found from the group of 43 extracted Class III molars, 118 canals (93.6%) were found without the aid of the endoscope, and 8 canals (6.4%) were found only with the aid of the endoscope. No mandibular first molar D2 canals were found, but 4 MB2 canals from the maxillary first molar were found using the endoscope. 3 teeth (7.0%) experienced perforations in attempting to locate the very calcified canals.

Conclusion and Discussion: This experiment demonstrates the necessity to include an evaluation of the pulp chamber size before undertaking endodontic treatment. The endoscope did not perform as well as expected. Factors such as the limited experience of the operators, the bulky non-flexible head of the endoscope, the focal length, and the inability to maneuver an explorer and endoscope simultaneously hindered the endoscope’s efficacy as an adjunct technique. Furthermore, the high percentage of canals found by using just the explorer and cavitron demonstrates that most canals can be found without using the endoscope or additional magnification.

Post-Doctoral Student Abstracts

Infections of Dental Origin

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Background and Objective: Pediatric dental caries is a progressive and consequential disease of early childhood that can have serious and life-threatening medical sequelae. However, little research has been conducted regarding head and neck infections of dental origin in pediatric populations. The aim of this preliminary study is to investigate the frequency, severity including morbidity and mortality, and identified causal organisms associated with dental-related head and neck infections in children aged 12 and under.

Materials and Methods: Three hundred and fifty-nine US program directors in the specialties of 1) pediatric dentistry, 2) oral and maxillofacial surgery, 3) pediatric emergency medicine, 4) pediatric infectious disease, 5) pediatric otolaryngology, and 6) child neurology were invited to participate in a brief questionnaire which included items on frequency of pediatric dental-related head and neck infections, complications of those infections, and identified causal organisms. The data collection period was limited to a three month period with surveys sent and returned via an encrypted electronic survey program and are to be analyzed using a statistical software package.

Results and Conclusions: Data collection is currently in progress. We have currently collected 132 responses (37% of invited participants).

Discussion: There is little research on the frequency of head and neck infections from odontogenic origin in pediatric populations. While this is a preliminary survey study and will be limited by subject recall bias, we hypothesized a significant number of program directors will report cases of infections of dental origin in children aged 12 and under and that a significant number of those cases will include consequential morbidity including airway obstruction, hospital admission, and mortality. Additional research on dental-related pediatric head and neck infection and their complications is needed.

MEPE Effects On Hydroxyapatite Formation and Growth Depend On Post-Translational Modification

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Introduction: Matrix extracellular phosphoglycoprotein (MEPE) is a member of the SIBLING family of extracellular matrix proteins. These proteins are multifunctional having both signaling properties and involvement in the regulation of mineralization. MEPE is cleaved in situ by PHEX yielding an ASARM peptide which has been shown in cell culture studies to be an effective inhibitor of biomineralization.

Objective: We are testing the hypothesis that post translational modification of MEPE is important in hydroxyapatite formation and growth.

Materials and Methods: A gelatin gel diffusion system was used to compare the effects of intact MEPE (with and without phosphorylation) and the ASARM peptide (with or without phosphorylation) in the presence or absence of fibrillar collagen. Effects were also examined in the presence of 0.5mg/ml hydroxyapatite (+HA) seed crystals.

Results and Conclusions: As reported in culture, in the gel diffusion system, the phosphorylated, and to a lesser extent, the dephosphorylated ASARM peptide inhibited HA formation and growth. In contrast, the intact MEPE promoted HA formation in a concentration dependent manner. The dephosphorylated intact protein had no effect. These results demonstrate that post-translational modification of MEPE determines its ability to promote or inhibit hydroxyapatite formation and growth.

Discussion: Further studies could look at the effect of glycosylation of the ASARM fragment.

Utilization of Emergency Services for Non-Traumatic Dental Disease

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Introduction: Without routine preventive dental care, children are more likely to develop dental emergencies. Treatment in an emergency setting is not an optimal situation for dental care, as treatment is time consuming, more costly, and less definitive than care provided during regularly scheduled appointments. This study seeks to identify and characterize children who utilize emergency dental services at the New York Presbyterian Hospital-Columbia University Medical Center Pediatric Dental Residency Clinic for treatment of non-traumatic dental disease.

Objective: The purpose of this prospective study is to determine why children under the age of 12 seek emergency dental care at the New York Presbyterian-Columbia University Medical Center Pediatric Dental Residency Clinic and to identify factors that contribute to their returning for regularly scheduled care. We tested the hypothesis that children who utilize emergency services for their first dental visit are more likely to return for future emergency visits as opposed to routinely scheduled comprehensive care.

Materials and Methods: Caregivers of children 12 years of age and under, who sought emergency dental services for the treatment of non-traumatic dental disease between October-December 2008, were asked to complete a questionnaire pertaining to their child's current oral health status, current strategies for management of dental disease, frequency of routine dental visits, and history of previous need for emergency dental care. Patients were further followed for a period of 2 months [through February 28, 2009] to determine if they complied with recommendations for comprehensive dental care. Data analysis will compare and contrast those who routinely utilize emergency care for symptomatic treatment versus those who return for more comprehensive scheduled appointments.

Results: Data analysis is currently in progress. At this time, a total of 198 participants are enrolled in the study. Preliminary results support the hypothesis that children who utilize emergency services as their first dental visit are more likely to return for emergency services as opposed to comprehensive care.

Discussion: The data collected will be analyzed to establish the scope of the children's dental emergency problems at the New York Presbyterian Hospital-Columbia University Medical Center Pediatric Dental Residency Clinic and the extent to which such children and their families complete the prescribed course of treatment for non-traumatic dental disease. The study will also examine the relative importance of various factors (for example, diet, personal dental hygiene habits, previous dental history, overall oral health status) in predicting their likelihood of returning for routinely scheduled comprehensive care.

Evaluation of a Behavior Change Goal Setting Action Plan on Oral Health Activity and Status

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Background: Goal setting action planning (GSAP) is a system for engaging patients in behavior modification consideration based on emerging collaborative models of patient care and concepts of self-efficacy. In this exemplar, patients set a goal for a behavior they wish to change, and clinicians engage patients in a discussion of an action plan, concrete and specific, that can help the patient fulfill the goal. To boost the probability that patients will be successful with their action plan, clinicians ask patients to choose one item, on a pictogram, that they can carry out and help patients tailor make an action plan that they consider doable. Patients are encouraged to choose one item with a high probability of success because success in making a behavior change, no matter how minute, increases patient self-efficacy. Joint GSAP with clinician and patient together deciding on concrete behavior change goals may be more effective in encouraging healthy behaviors than conventional clinician-directed instruction.

Objective: This study explores 1) whether it is feasible for clinicians to engage parents of patients with early childhood caries risk factors in collaborative goal-setting and concrete action planning during the initial dental evaluation visit and 2) to determine the effectiveness of a personalized detailed oral health action plan in improving parent-patient oral health behaviors and oral health status of the child.

Materials and Methods: In this quasi-experimental design, pediatric child patients between the ages of 2 and 5 years who participated in the study were divided randomly into control and intervention groups. In addition to the routine oral health instructions given to the control group, the intervention group received a personalized oral health action plan with one specific goal for the follow up visit. This study consisted of five key elements: 1) assessment of the child's current caries risk status, 2) assessment of the child's current oral health behavior status, 3) creation of a single "goal" for next visit, and 4) saliva sampling as a biomarker for behavior change. At initial and follow up visits, patients were examined and data collected including a plaque score using a modified version of the criteria of the Silness and L e [1964] plaque index, caries presence/absence registration as measured by the decayed teeth index, gingival health, mutans streptococcus (MS) levels, and oral health and diet behaviors as reported by parent interview. Data collected at initial and follow-up visits were compared and analyzed. Scores for each child were obtained by one trained examiner. For microbial analysis, resultant growth intensity samples were read and categorized as low, moderate, high, or too numerous to count in order to classify the child's MS finding.

Results and Conclusions: Data collection is currently in progress. Preliminary data analysis of 15 cases and 15 controls suggest that the majority (83%) of the patient encounters resulted in a behavior-change as evidenced by reduced MS levels. Parents (79%) rated the discussions as more satisfying than previous behavior-change discussions and instructions, and the clinician examiner identified time constraints as the most important barrier to adopting the goal-setting process.

Discussion: Self-efficacy has been associated with improved health-related behaviors and clinical outcomes. We observe that collaborative goal-setting between clinicians and parents of child patients for improved health behaviors is viewed favorably by parents and has a positive impact on clinical outcomes as evidenced by reduced MS counts on microbial analysis on follow up clinical examination. Behavior change goal setting action plans may be a promising technique for assisting parents improve child oral health activity and behaviors.

Association of Family Dynamics and Pediatric Oral Health

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Background: Dental caries is a complex disease influenced by numerous risk factors, mainly biological, social, and psychological variables. It is difficult to establish distinct correlations between such variables and the prevalence and/or incidence of caries in children. However, conception of key risk factors to a child can appreciably influence success in achieving and maintaining best possible oral health by developing customized interventions. At the pediatric dental residency clinic, parents receive oral hygiene instructions at their children's dental visits. Nevertheless, considerable numbers of children continue to present with meager oral hygiene, recurrent or new carious lesions, or present as emergencies related to caries. Consequently, it is essential to appreciate some of the specific family-related factors that hamper the parents' capacity to control the caries process in their children. Family unit dynamics to be investigated include co-habitation of the parents, number of siblings, number of people residing at home, number of dependents living at home, and the establishment of a 'dental home' for the child. Measurements of compliance will be determined by analyzing two key essentials: 1) prevalence of carious lesions and 2) emergency walk-in visits.

Objective: To examine the relationship of family structure and dynamics on dental caries in children receiving care at the pediatric dental clinic. The data collected can be used to develop targeted oral health educational interventions for children and their families.

Materials and Methods: Study population consists of a random sample of 100 parent/guardian-child pairs presenting for initial examinations. Inclusion criteria are children age 4 to 8 years and initial dental examination. Oral health status is determined by prevalence of dental caries and plaque index. Dental caries is measured using the *dmft* index. Independent variables are assessed by use of a 16-item instrument administered to parent/guardians. Demographics, parents' co-habitation, number of siblings, number of people living at home, number of dependents living at home (not limited to children), and establishment of a dental home for the subject are assessed.

Results and Conclusions: Preliminary descriptive data (n=15) indicates that 93 % of the children live in five or fewer individual households, 90 % of mothers have less than a complete high school education, and 93 % of children live in two parent households. The average *dmft* was 4.8, 66.7 % of the children had a *dmft* of zero, and 83 % of these children had parents who had completed high school. Eighty percent of the children were Hispanic, and twenty percent were Black/African American. Eighty percent of parents were born outside the US, 6.7 % of the parents were born in the US, and 13 % did not give a response to country of origin.

Discussion: The results suggest that improved oral health status is strongly correlated with the mother's level of education. The majority of the children with good oral health status (*dmft* of zero) had mothers who completed high school or higher level of education. Because most of the children resided in a two-parent household with equal to or less than five total occupants, the suggestion is that, at this time, there is no direct correlation between the number of household occupants and the oral health status of the children in this study population. High prevalence of dental caries in this population suggests that in addition to preventive interventions such as fluoride and sealants, this population would benefit from improved oral health education and outreach.

Predictors of Parental Assessment of Child's Oral Health in Northern Manhattan, New York City

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Background: Self assessed health has been proven to be a valuable tool in medicine. Adults overall have been found to have a consistent individual assessment of their own oral health status. Various research has also been done on parental perception of children's oral health. Comparisons have been made between dental ratings and self assessed oral health in adolescent populations. Demographics and clinical predictors of parent assessed oral health in large national studies of young children have also been examined. Little research has been done to determine other social and clinical predictors of parent assessed oral health in young children including 1) enrollment in Head Start, 2) patient and parental behavior at the time of examination, and 3) presence of plaque and clinical abscess.

Objective: To determine the clinical and social factors that forecast parental assessed oral health in a population where the overwhelming bulk are of low-income, minority (primarily Latino), immigrant children aged 2-5 years old attending a pediatric dental clinic in the Washington Heights and Inwood neighborhoods of Northern Manhattan, New York City.

Methods: A questionnaire was given to parents with a child aged 2-5 years presenting to the Columbia University College of Dental Medicine Pediatric Dentistry Clinic assessing 1) participation in Head Start, 2) knowledge about their child's oral health, as well as 3) behaviors and attitudes regarding their child's oral health. Additionally, a routine clinical examination was performed on the parent's child assessing presence and absence of plaque, decayed and filled teeth, clinical abscess presence or absence, and the child's behavior. All parent participants and their children were recruited by a single examiner during the initial or oral hygiene maintenance follow up examination at the pediatric dental clinic. A univariate and bivariate analysis will be conducted utilizing SAS.

Results and Conclusions: This study is ongoing and data collection is in progress. The available data suggest that enrollment in Head Start may be a good predictor of parent assessed oral health in young children. Plaque presence or absence and clinical abscess presence or absence appear to show less forceful association to predicting parental assessed oral health.

Discussion: In preschool aged children, parental perception is significant since children are not old enough to be accurate historians of dental pain nor are they able to properly communicate degree of dental pain. Social and cultural norms may play a considerable role in determining a parent's assessment of his/her child's oral health. Determining the accuracy of parental perception can improve children's oral health and allow timely delivery of necessary dental treatment.

A Comparison of the Levels of Biochemical Inflammatory Interleukin-1 β in Gingival Crevicular Fluid (GCF) between Adults with a Healthy Periodontium and Adults with a History of Periodontal Disease during Orthodontic Treatment

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Introduction: Orthodontic treatment is quite challenging on patients with previous and/or existing periodontal disease and is now more prevalent as increasing numbers of adult individuals become interested in orthodontic treatment. Cytokines are regulatory proteins secreted by white blood cells and a variety of other cells in the body. Several studies have illustrated up and/or down regulation of different cytokines in response to mechanical forces used in orthodontic treatment in gingival crevicular fluid (GCF). It has been shown that, in humans with severe periodontal disease, significantly higher levels of IL-1 β were found compared to individuals with a healthy periodontium.

Objective: To examine GCF levels of IL-1 β during orthodontic tooth movement in adults with healthy periodontium and in adults with a history of periodontal disease.

Materials and Methods: The study included 8 patients, 4 of them with healthy periodontium and 4 with a history of periodontal disease. All 4 molars had bonded molar tubes and were uprighted continuously with 0.017" x 0.025" titanium molybdenum alloy (TMA) uprighting springs using 30 cN of force. The GCF was sampled at all pressure sites twice with two weeks of separation as observation control before activation and at 1, 7, 14, and 21 days. Prevention of plaque-induced inflammation allowed this study to focus on the dynamics of mechanically stimulated IL-1 β GCF levels. The IL-1 β levels were determined with enzyme-linked immunosorbent assay.

Results and Conclusions: IL-1 β can be detected in the GCF of healthy adult patients and in patients with a history of periodontitis. Patients with a history of periodontitis displayed higher amounts of fluid volume and higher concentrations of IL-1 β (pg/strip) at baseline and at treatment time without significant changes being induced through orthodontic movement. The mechanical stimulation of 30cN seemed to be too low to stimulate IL-1 β production. The overall mean total amount of IL-1 β remained stable over time also when compared to the antagonistic teeth.

Discussion: The increased GCF volume of adult patients with a history of periodontitis could either be a marker for subclinical periodontitis or for a genetic predisposition for IL-1 β expression. The low mechanical force (30cN) used might explain why IL-1 β remained unaffected. Our pilot study suggests for future studies the inclusion of a greater patient sample, the use of higher mechanical force, the refinement of the GCF sampling (a steady predetermined collection time and repeated sampling at the pressure and tension side), and the use of the cytokine levels on experimental teeth as the baseline for control.

Preprosthetic Intrusive Mechanics: An Alternative Method for Overextruded Second Molars in Adult Patients

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Introduction: Unopposed molar teeth are believed to be at risk for overeruption, impaired masticatory function, and the development of temporomandibular disorders; these are all problems frequently observed by both general practitioners and specialists. Two approaches are currently in use to correct overerupted/extruded posterior teeth: 1) the prosthodontic approach, which reduces the vertical height of the crown of the extruded tooth, and 2) the orthodontic approach. With the prosthodontic approach, prior endodontic treatment might be necessary depending on the amount of extrusion. The orthodontic approach is challenging due to the multiple roots of the molar teeth; there is greater resistance to intrusion forces because of the greater root surface area. A good anchorage system is also necessary to counteract the side effect of the extrusion of the adjacent tooth. This report presents two cases successfully treated with a novel orthodontic approach for selective molar intrusion: the modified palatal arch appliance.

Objective: To intrude overerupted maxillary second molars.

Materials and Methods: We designed the modified palatal arch appliance according to a calculated standard vector model. The buccal step bend would exert a force of 45 gm and would act in a direction 25° from the modified palatal arch appliance with the force of 50 gm. The resultant force vector was calculated as $F_R = [45^2 + 50^2 - 2 * 45 * 50 \cos(180^\circ - (25^\circ))]^{1/2} = 92.8$. With this model, we would obtain an intrusive force of 92.8 gm combined with clinically negligible distal and palatal crown tipping each of less than 15°. Of course, each clinical application would have variable effects due to the individual environment. The modified palatal arch appliance represents a force system that is equivalent to a couple with a 30 gm net force to move the tooth bodily. A short length of elastomeric chain from the helix to the palatal sheath of the maxillary second molar applied 50 gm of force to the overerupted maxillary second molar. The elastomeric chain was replaced every three weeks.

Results and Conclusions: Sufficient intrusion of the maxillary second molar was obtained within two months. The modified transpalatal arch appliance can be used successfully to intrude overerupted maxillary second molars and presents a clinically elegant, non-invasive, and cost-effective procedure because it does not require laboratory work. This appliance can be realized in one chairside appointment.

Discussion: When intrusion of one single tooth is needed, the modified palatal arch appliance is an attractive orthodontic alternative to traditional edgewise mechanics, temporary anchorage devices, or removable appliances. The traditional edgewise side effect of intrusion of the adjacent tooth did not occur. Not all patients are candidates for insertion of temporary anchorage devices, either for psychological, medical, or anatomical reasons. Also, the use of removable appliances does not seem to be indicated when the terminal tooth requires intrusion.

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