University of Mississippi Medical Center
School of Dentistry

Research Day 2015

February 24, 2015

Gary Reeves, DMD
Dean

Jason A. Griggs, PhD, FADM
Associate Dean for Research

School of Dentistry Office of Research
University of Mississippi Medical Center
2500 North State Street, Room D528-6A
Jackson, MS 39216-4505

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Welcome

Dear Participants and Guests,

Welcome to the School of Dentistry Research Day 2015!

Since 1994 the School of Dentistry Research Day has provided a forum for faculty and students involved in research, including undergraduate, predoctoral and graduate students, to come together to present their research findings to members of the School and the broader community. We particularly wish to welcome our guests from our neighboring institutions, whom we hope will share our excitement about the diverse and highly significant research being presented today.

Involvement in research is one of the most enriching experiences that students can have. Here at the School of Dentistry we are very proud of the students who take their education beyond the classroom, as well as our faculty members who provide invaluable mentorship in biomedical, translational, educational, epidemiologic, and clinical research through the UPSTART Program. This program complements the evidence-based approach to oral health care that our students study in their didactic coursework.

Once again, welcome, and thank you for being a part of the School of Dentistry Research Day 2015.

Sincerely,

Gary W Reeves, DMD, Dean

This is an exciting day for the School of Dentistry! We have some fascinating demonstrations planned and have a new, larger venue for our poster presentations. I am grateful for the advice from faculty, staff, and students that resulted in these innovations. I am also thankful to Dr. Gary Reeves, Dean of the School of Dentistry, for his continued support of research through intramural seed grants, bridging funds, travel funds, and funding for today's activities.

It is a pleasure to have Dr. Yu Zhang with us today as our keynote speaker. I have known Dr. Zhang for many years. He has the heart of a teacher and a relaxed and warm style of communication that the native Mississippians in our gathering will find very familiar. He is the inventor of a new layered ceramic restorative system that has resulted in several patents, and he has been very successful in obtaining funding from both the NIH and the NSF.

As usual, the abstracts that we received this year are excellent, and I look forward to hearing our students and faculty present their results and discuss the scientific impact with all of you. Thank you for joining us.

Jason A. Griggs, PhD, FADM
Associate Dean for Research, School of Dentistry
Professor and Chair, Department of Biomedical Materials Science

Program

Lower Amphitheater R153

8:00 – 9:00 am Keynote Lecture: Dr. Yu Zhang
"Ceramics for Dentistry: Challenges and Opportunities"

Nelson Student Union Gymansium

9:15 – 10:00 am Break
Poster preparation

10:00 – 11:30am Poster presentations
Judging of student posters
Biomedical Materials Science lab demonstrations

Nelson Student Union Conference Rooms C and D

11:30 am Lunch will be served

12:15 pm Certificates and awards presentation

12:45 pm Poster removal

Acknowledgements

Faculty Research Mentors

Jennifer Bain, DMD, MSPH, PhD
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Poster Judges

Ahmad Abdelkarim, DDS, MS, PhD
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Olga McDaniel, MD
Professor, Surgery

Kenneth St. John, PhD
Associate Professor & Graduate Program Director, Biomedical Materials Science

School of Dentistry Administration

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Dr. Jennifer Bain

Keynote Lecture

"Ceramics for Dentistry: Challenges and Opportunities"

Yu Zhang, PhD

Associate Professor
Department of Biomaterials and Biomimetics
New York University, New York, NY

Dr. Yu Zhang received his PhD in Materials Science and Engineering from Monash University, Australia in 2002. From 2002 to 2005, he worked as a Postdoctoral Fellow at the Materials Science and Engineering Laboratory, National Institute of Standards and Technology, Gaithersburg, MD.

In February 2005, Dr. Zhang joined the Department of Biomaterials and Biomimetics at the New York University College of Dentistry as an Assistant Professor, where he was promoted to Associate Professor in July 2011. His research interests include the development of functionally graded ceramics having improved damage resistance, esthetics, and bioactivity. This research is supported by both NIH/NIDCR and NSF/CMMI. He is also developing calcium phosphate-based materials for bone therapy (supported by NIH/NIAMS), and he is developing improved methods to evaluate the mechanical reliability, fatigue damage resistance, and longevity of biomechanical structures, including all-ceramic dental restorations.

Dr. Zhang has published over 70 journal articles and book chapters. He also has filed 5 US and EU patent applications.

Poster Abstracts

bold print signifies student researcher
*signifies presenter if not first author

Targeted Delivery of Osteoinductive Peptides to Bone Graft Utilizing a Hydroxyapatite Binding Domain to Enhance Regenerative Capacity

JL Bain[1], PB Bonvallet[2], RV AbouArraj[3], MS Reddy[3], SL Bellis[2]

[1]Department of Periodontics & Preventative Sciences, University of Mississippi Medical Center; [2]Department of Cell, Developmental, & Integrated Biology, University of Alabama at Birmingham; [3]Department of Periodontology, University of Alabama at Birmingham

Objective: Autogenous bone is the gold standard in craniofacial regenerative medicine. However, harvesting bone is associated with complications that often lead clinicians to use allograft or xenograft materials that may lose their osteoinductivity due to processing. Alternatively, products are available with bioactive factors such as rhBMP2 passively absorbed onto a collagen sponge. These materials, while effective, are expensive to produce, require supraphysiological doses, and have adverse side effects due to dissemination away from the graft site. The aim of this study was to reintroduce osteoinductive factors to bone graft to enhance regenerative capacity. Specifically two peptides known to induce osteoblastic differentiation were evaluated: a BMP2-mimetic peptide (BMP2pep) that binds the BMP2 receptor, and DGEA, a domain within collagen I. These peptides were anchored to the graft utilizing a heptaglutamate domain (E7), which binds specifically to hydroxyapatite. This allows for sustained delivery of peptides from the graft surface. E7-modified peptides are cost effective and simple to produce.

Methods: Equimolar solutions of FITC-tagged peptides ± E7 were added to commercially available particulated bovine bone and imaged via fluorescent microscopy to determine binding efficiency. To evaluate peptide retention on the graft surface the grafts were coated and implanted into rat subcutaneous pouches for 8 weeks and imaged. To assess if the grafts induced ectopic bone formation, peptides ± E7 (without FITC) were coated onto grafts and placed into rat subcutaneous pouch. H&E staining and polarized light imaging was performed and the area of new bone quantified using NIS Elements. To determine if E7-peptides induced bone regeneration a critical size mandibular defect was created in rats. CT and PET images were taken on live animals to evaluate bone activity, and were data quantified using Image J.

Results: Direct visualization of grafts showed greater binding of E7-peptides to the graft surface. Moreover, a greater quantity of E7-peptides was retained on the grafts for 2 months *in vivo,* which is sufficient time to influence bony healing. Histologically, E7-peptides showed greater ectopic bone formation than grafts coated with unmodified peptide or uncoated graft. The E7-BMP2pep group exhibited the most ectopic bone formation compared to all other peptides and the amount of new bone was comparable to that seen with rBMP2 (full length protein). PET imaging of the mandibular defects showed greater osteoblastic activity in the E7-BMP2pep groups than all other groups at 4 and 8 weeks.

Conclusion: E7 domains provide an effective mechanism for sustained delivery of osteoinductive peptides from commercial graft materials, evidenced by the finding that E7-BMP2pep was as effective as rBMP2 in inducing new bone synthesis. E7-modified peptides improve regenerative potential without the deleterious effects or high cost of currently available passively absorbed products that disseminate from the graft site. Acknowledgements: This research was supported by a NRSA F32 Individual Fellowship (NIDCR 1F32DE022997-01) and by a grant by Osseointegration Foundation.

Bimaxillary Surgical Planning Utilizing a Novel Face-Bow Transfer Method to Accurately Capture the Occlusal Plane Angle and Coordinate Data Sets

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[1]Department of Oral-Maxillofacial Surgery & Pathology, University of Mississippi Medical Center; [2]Department of Biomedical Materials Science, University of Mississippi Medical Center; [3]Center for Biostatistics & Bioinformatics, University of Mississippi Medical Center; [4]Department of Care Planning & Restorative Sciences, University of Mississippi Medical Center

Objective: To evaluate the accuracy and reliability of a novel face-bow transfer method to capture the occlusal plane angle and coordinate data sets for bimaxillary surgical planning.

Methods: Ten patients with dentofacial deformities were included in this retrospective study. All surgeries were performed using a novel face-bow transfer articulated model planning method that was developed by the principal investigator. The occlusal plane angles to true horizontal were measured and compared between articulated models and photo-ceph superimpositions. Qualitative assessments were also performed to compare the vertical maxillary height and cant deformity between mounted models and photo-ceph superposition to evaluate the correlation of two incongruent data sets.

Results: The mean occlusal plane to the true horizontal on the photo-ceph superimposition and articulated maxillary models were 6.7 and 6.8 degrees respectively. Two methods were found to be statistically equivalent by the result of equivalence testing. The mean difference between the Frankfort plane and true horizontal line on the photo-ceph superimposition was 2.1 degrees. The mean differences of anterior vertical maxillary heights between the two data sets was 2.2 mm. Cant assessment on the mounted models and clinical exam showed that in all but two cases there was a good correlation.

Conclusion: This novel face-bow transfer surgical planning method was found to be able to accurately capture the occlusal plane angle and coordinate data sets for orthognathic surgery. It should provide more accurate planning in obtaining desired jaw movements, although there are still inherent errors in the planning process.

Poster Abstracts

bold print signifies student researcher
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Systemic *Porphyromonas Gingivalis* Endotoxin Attenuates Fibroblast Matrix Deposition Post-Myocardial Infarction

KY DeLeon-Pennell[1], E Flynn[1], YF Jin[1,2], W Buchanan[3], ML Lindsey[1,4]

[1]San Antonio Cardiovascular Proteomics Center, Mississippi Center for Heart Research, and Department of Physiology & Biophysics, University of Mississippi Medical Center; [2]Department of Electrical and Computer Engineering, University of Texas at San Antonio; [3]Department of Periodontics & Preventative Science, University of Mississippi Medical Center; [4]Research Service, G.V. (Sonny) Montgomery Veterans Affairs Medical Center

Objective: Periodontitis is associated in epidemiologic studies with an increased risk for cardiovascular disease. This association is hypothesized to be triggered by circulating endotoxins from periodontitis lesions. Our previous studies in mice revealed chronic *Porphyromonas gingivalis* lipopolysaccharide (*Pg*LPS) exposure increased systemic inflammation, which when superimposed on myocardial infarction (MI), increased and accelerated the number of left ventricle (LV) ruptures. In this study, we hypothesized that circulating *Pg*LPS decreased myofibroblast differentiation leading to an impaired healing response post-MI.

Methods: Mice (4-6 months old; both sexes; n=12/group) infused with either *Pg*LPS (0.08 μg/g/day) or saline starting at 28 days before and continuing for the duration of MI using a permanent occlusion model of MI, sacrificing animals at D7 post-MI. Echocardiography and immunoblotting was performed to examine the infarct fibrotic response.

Results: Echocardiography at D7 post-MI showed a decrease in fractional shortening (FS) and an increase in wall thinning in mice exposed to *Pg*LPS (FS=5±1%; wall thinning=49%) compared to saline MI controls (FS=7±1%; wall thinning=23%; $p \leq 0.05$). Immunoblot analysis showed at least a 2-fold decrease in collagen I, collagen III, fibronectin, and lysyl oxidase (LOX) in the LV infarct of *Pg*LPS exposed mice compared to saline controls (all $p \leq 0.05$). Post-MI, fibroblasts differentiate into myofibroblasts stimulating an increase in extracellular matrix (ECM) production to form a scar. Alpha smooth muscle actin, a myofibroblast marker, decreased in the infarct area of *Pg*LPS exposed mice compared to saline controls ($p \leq 0.05$) indicating the decrease in ECM deposition was due to a decrease in myofibroblasts activation.

Conclusion: Our study uncovered a novel mechanism for periodontitis induced cardiac dysfunction and impaired healing post-MI through down regulation of myofibroblast activation and reduced ECM deposition during post-MI scar formation. Acknowledgements: This work was supported by American Heart Association 13POST14350034 to KYD-P and by the National Institute of Health/National Heart, Lung, and Blood Institute HHSN 268201000036C (NOI-HV-00244) for the San Antonio Cardiovascular Proteomics Center and ROIHL075360 and from the Biomedical Laboratory Research and Development Service of the Veterans Affairs Office of Research and Development Award 5IOIBX000505 to MLL and by HL051971 and GM104357.

Comparison of 3D Computer-Assisted Virtual Planning and Articulated Model Planning for Bimaxillary Orthognathic Surgery

R Caloss[1], Y Duan[2], J Parthasarathy[3], **W Jing[1]***

[1]Department of Oral-Maxillofacial Surgery & Pathology, University of Mississippi Medical Center; [2]Department of Biomedical Materials Science, University of Mississippi Medical Center; [3]MedCAD, Dallas, TX

Objective: Articulated model surgery has been the established method for planning bimaxillary orthognathic surgery. However, computer-assisted virtual planning is gaining popularity. The purpose of this study was to perform a side-by-side comparison of these two methods to assess if there is a clinically significant difference in three-dimensional (3D) dental movements between them. Our hypothesis was that there would be no significant difference.

Methods: Surgical records for this retrospective study were gathered for ten patients who previously underwent bimaxillary orthognathic surgery at our institution. Standard records included intra- and extraoral photos, cone beam computed tomogram (CBCT), and two-dimensional virtual treatment objective using Dolphin Imaging®. Also, two sets of dental models were mounted on a semi-adjustable articulator using a facebow transfer and centric relation (CR) record obtained by the principal investigator. A standard mounting protocol was used that ensured accurate capture of the occlusal plane angle. Model surgery was performed for surgical splint fabrication. Subsequent to surgery, the cut and uncut models were remounted on the same articulator to create a new CR record and an intermediate and final splint for each case. These records were made using polyvinylsiloxane bite registration material. Maxilla-first surgery was always performed. The 3D changes in the molar, canine, and incisor positions for the maxilla and mandible were measured using an Erickson model block. The principal investigator performed all measurements. All relevant records were then sent to MedCAD® for virtual planning. CBCT data, dental models, and the CR record were used to create a 3D composite model. Clinical photos and measurements were provided for model orientation. FreeForm Modeling® and Dolphin Imaging® software were used to perform virtual surgery per MedCAD's routine protocol. The intermediate and final splints were used to position the maxillary and mandibular models into their new positions. GeoMagic Studio® software was used for this registration. The final registered models were imported into Dolphin, and autorotation was performed appropriately to make the vertical incisor change coincident with the vertical change in the articulated model surgery. 3D changes were measured for comparison with articulated model moves. The same engineer performed all modeling and was blinded to the articulated model moves. The maximum difference, mean difference, and standard error between the two methods were calculated in three

dimensions

Results: The surgical movements in the anteroposterior dimension ranged from 3.5 mm to 8.3 mm at the maxillary incisor and -4.0 mm to 12.0 mm at the mandibular incisor. The vertical movement at the maxillary incisor ranged from -2.4 mm to 2.0 mm. The maximum differences between the two methods in the anteroposterior, vertical, and transverse dimensions were 1.2 mm, 1.6 mm, and 0.9 mm, respectively for both jaws. The mean differences and standard errors between the two methods for anteroposterior, vertical, and transverse dimensions in the maxillary arch were 0.4 mm (0.04), 0.3 mm (0.04), and 0.3 mm (0.04), respectively. The mean differences and standard errors for anteroposterior, vertical, and transverse dimensions in the mandibular arch were 0.4 mm (0.05), 0.5 mm (0.08), and 0.4 mm (0.05), respectively.

Conclusion: The overall difference in 3D dental movements between the articulated model and virtual planning methods was minimal and was clinically insignificant. Computer-assisted virtual planning with MedCAD's current protocol seems like a reasonable alternative for planning surgical movements.

In Vitro Evaluation of Osteogenic Activity of Human Adipocyte Derived Stem Cells on Varied Scaffold Formulations

***P Bierdeman*[1], *B Gurumurthy*[1], *AV Janorkar*[1]**

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center

Objective: According to the Centers for Disease Control and Prevention, periodontal disease affects roughly 47% of adults above the age of 30 and increases with age. Periodontitis can cause a wide variety of symptoms from halitosis to caries, or even loss of teeth. Tooth loss is often followed by alveolar bone resorption. Guided bone regeneration is the available treatment for regeneration of alveolar bone lost by periodontitis. The currently used collagen scaffolds suffer from rapid degradation and lack of rigidity. Our aim was to find a substrate suitable to support the growth of the alveolar bone to form a strong base for future dental treatments. We hypothesized that Human Adipose Derived Stem Cells (hASCs) would differentiate along the osteoblastic lineage better in a more firm substrate.

Methods: To this end, hADSCs were isolated from a patient undergoing elective abdominoplasty and were cultured over a period of 22 days in composite hydrogels prepared using various concentrations of collagen and elastin-like polypeptide (ELP). ELP was added to increase the elastic modulus (firmness) of the scaffold as established in our previous studies. After 3 days of acclimation, the stem cells were differentiated using an osteogenic medium cocktail, and the growth was analyzed on days 8, 12, and 22. After each culture period, the cells were harvested from the hydrogel scaffolds using collagenase. Biochemical characterization was done using live/dead assay, total protein assay, alkaline phosphatase assay, and alizarin red mineralization assay. Statistical analysis was done using Games-Howell *post hoc* test and ANOVA test.

Results: Live/dead assay performed on day 22 indicated abundant cell growth with only a small population of dead cells. The scaffold with increased concentration of ELP and collagen showed high amount of normalized protein levels, alkaline phosphatase activity, and mineralization.

Conclusion: Overall, our results suggest ELP-collagen hydrogels to be a suitable scaffold substrate for a long-term, three-dimensional hADSCs culture and their subsequent osteogenic differentiation. Further studies are needed to know the efficiency of these scaffolds for their use in bone tissue engineering. Supported by the National Institutes of Health/National Institute of Dental and Craniofacial Research (R03DE024257).

Effect of Fluorination Treatment on the Hydrolytic Degradation Resistance of Y-TZP

GV Joshi*[1], *J Piascik*[2], *JA Griggs*[1]

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center; [2]RTI International, Center for Materials and Electronic Technologies

Objective: We recently reported improved resistance of yttria-stabilized tetragonal zirconia polycrystal (Y-TZP) against Y-leaching by molten porcelain following surface fluorination treatment. The increase in placement of full-coverage Y-TZP restorations poses the question of whether fluorination will also improve the resistance of Y-TZP to low-temperature degradation as simulated by autoclaving.

Methods: Rectangular beam specimens (25 mm x 4 mm x 3 mm) of Y-TZP (IPS e.max ZirCAD, Ivoclar Vivadent) were fabricated. The specimens were polished to a 15-μm surface finish and divided into three groups. Group C (n=10) were controls. Groups F and FA (n=11) were subjected to the fluorination treatment in a planar, inductively coupled 13.56 MHz plasma operated at 800 W with a dc bias of -300V for a total time of 20 minutes. Then, Groups FA and A (n=11) were subjected to an accelerated hydrothermal aging treatment in an autoclave at 134˚C and 2.15 bar pressure for 20 h. Grazing incidence X-ray diffraction analyses (n=3) were performed at a fixed angle of incidence of 1˚ using a diffractometer (XDS 2000, Scintag) with Cu-Kα radiation (2θ=27-33˚, step size=0.02˚, and dwell time=1.5 s). The monoclinic phase fraction at the surface was calculated using the Garvie and Nicholson method. Then, all of the specimens were subjected to rapid monotonic loading at 10 MPa/s until failure using a fully articulated four-point flexure fixture in deionized water at 37˚C, and the strength of each specimen was calculated. A Weibull distribution was fit to the strength data from each group (Weibull++, Reliasoft). The groups were compared using one-way ANOVA followed by Tukey's HSD with α=0.05 (SigmaPlot, Systat).

Results: The monoclinic phase fractions (mean±standard deviation) for Groups C (control), A, F, and FA were 0±0%, 3.9±0.3%, 0±0%, and 18±7%, respectively. The mean strength values were

750±86 MPa, 817±59 MPa, 916±47 MPa and 834±45 MPa, respectively.

Conclusion: Two-way ANOVA showed a significant effect of fluorination resulting in higher strength ($p<0.001$), and aging was associated with a significantly higher proportion of monoclinic phase for both fluorinated and non-fluorinated specimens ($p=0.002$).

Fibula Jaw in a Day: State of the Art Reconstruction

*M Qaisi[1], H Kolodney[1], G Swedenburg[1], R Chandran[1], **M Loeb[1]***, R Caloss[1]*

[1]Department of Oral-Maxillofacial Surgery & Pathology, University of Mississippi Medical Center

Objective: The microvascular fibula free flap, popularized by Hidalgo, has been one of the greatest milestones in reconstruction of the mandible and maxilla after tumor surgery. Although fibula free flap reconstruction allows for immediate bony reconstruction, dental rehabilitation usually requires 6-12 months before it is complete. This can be a source of inconvenience and can affect the patients psychologically as they go without a dentition during this period.

Methods: We present two cases in which tumor resection and complete jaw reconstruction with immediate dental rehabilitation was performed all in one surgery. This study was assigned exempt status by the Human Research Office because the sample size is too small at this point to constitute a research project. Virtual planning and prosthetic considerations are discussed and demonstrated through photos. The first group to successfully perform this "jaw in a day" procedure was a multidisciplinary group at New York University. To our knowledge we are the second group to report on this technique.

Both patients had a diagnosis of mandibular ameloblastoma involving the right side of their mandibles. Patient 1 was 75 years old and had a 4 cm lesion, and patient 2 was 23 years old with a 3 cm mandibular lesion. Virtual surgical planning was used to plan the resection and reconstruction using an occlusion driven approach in both patients. Plaster models of the patients' upper and lower dentitions were scanned and superimposed on the CT data in order to increase occlusal accuracy. During the virtual planning, positioning of the fibula segments and implants was done according to the simulated position of the prosthesis. Following production of the medical models, a prosthesis was fabricated to fit both the medical models and the opposing dentition.

During surgery, cutting guides were used for the mandibular resection. Cutting guides for the fibular osteotomies were fabricated with a built-in dental implant guide allowing for accurate placement of the dental implants. The dental prosthesis was then secured to the implants at the leg, prior to transfer up to the head. Upon transfer of the fibula-prosthesis complex to the head, it fit the adjacent mandible and the opposing dentition according to the virtual plan; minimal adjustment to the fibula was necessary. A prebent reconstruction plate was used to secure the fibula in place in both patients.

Results: The lengths of follow up were six and three months respectively for patients 1 and 2 at the time of this writing. On discharge both patients were placed on a soft non chew diet for a period of three months to decrease loading forces and allow bony union. Both patients had excellent occlusion postoperatively. At four months a CT of patient 1 was obtained confirming good bony consolidation between the segments and native mandible.

Conclusion: According to early post operative data, the "fibula jaw in a day" procedure seems to be a viable option in the immediate reconstruction of the mandible and associated dentition after tumor ablation. Collaboration between the reconstructive surgeon and maxillofacial prosthodontist is crucial. Long term follow up data is needed to validate these findings.

Effect of the Order and Particle Size of Silica-Coating on Y-TZP Strength

SM Salazar Marocho[1,2], *SD Manarão[2], Y Correia[2], PF Cesar[2], W Miranda[1], JA Griggs[1]*

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center; [2]Department of Biomaterials & Oral Biology, University of São Paulo

Objectives: To determine the four-point flexural strength of an yttrium stabilized zirconia polycrystal (Y-TZP) ceramic after different silica-coating protocols.

Methods: Y-TZP bar-shaped specimens (1.2 x 4.0 x 25.0 mm) were divided according to the different silica-coating protocols (n=28). The control group (a) did not receive any surface treatment. Groups (b) to (e) were silica-coated using silica-modified alumina particles with different sizes either before or after final sintering, as follows (particle size/SC order): (b) 30 μm/before sintering, (c) 110 μm/before sintering, (d) 30 μm/after sintering, and (e) 110 μm/after sintering. Silica- coating was performed perpendicular to the tensile surface of the Y-TZP bar (distance of 10 mm for 15 s at a pressure of 2.8 bars). Flexural strength data were analyzed using Weibull statistics.

Results: Silica-coating the Y-TZP surface either before or after final sintering resulted in statistically similar Weibull moduli, regardless of the particle sized used. The m value obtained for group (d) (30 μm/after sintering) was significantly higher than those obtained for both silica-coating with 110 μm particles before sintering and silica-coating with 110 μm particles after sintering. The Weibull modulus resulting from silica-coating with 110 μm particles after final sintering (group (e)) was significantly lower than the m values obtained for both groups treated with 30 μm particles and the control. As to characteristic strength, except for groups (a) and (d) which had statistically similar values, there were significant differences for all other pairwise comparisons. Group (e) (110 μm/after sintering) showed the highest characteristic strength; group (c) (110 μm/before sintering) showed the lowest characteristic strength.

Conclusion: Only particle size affected strength and variation in strength. Supported by FAPESP 2012/13727-3, CAPES 2093-14-6.

Poster Abstracts

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*signifies presenter if not first author

Corrosion Resistance, Bioactivity, and Wetting Angle Analyses of Anodized Titanium Surfaces for Potential Dental Implant Applications

***B Salmon*[1], *W Fontaine*[1], *RS Williamson*[1], *MD Roach*[1]

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center

Objective: Titanium dental implants are often anodized to enhance the surface oxide layer for improved osseointegration and bioactivity. Both the anatase (A) and rutile (R) phases of titanium oxide have shown antimicrobial effects and enhanced bioactivity. Previous studies have tested the antimicrobial effects of A and R powder mixtures in solutions covering titanium substrates, but have not yet conducted tests to determine the A/R phase ratio needed to produce the greatest antimicrobial effect. The first objective of the study was to develop a clinically relevant testing model that incorporates specific A/R phase ratios into the anodized layer on titanium substrates. A second objective was to use mixtures of common electrolytes to control the A/R phase ratio produced using a Response Surface Model (RSM) statistical design approach to allow prediction of the optimized electrolyte for each A/R ratio. After establishing a reliable method of anodization, several experiments testing wetting angle, bioactivity, and corrosion resistance were conducted in order to measure the biocompatibility in the oral cavity.

Methods: Commercially pure titanium grade 4 (CPTi-4) samples were cut from 2.00-mm thick sheet to 1-in^2 area samples and ultrasonically cleaned in alcohol. Samples were dipped in a nitric-hydrofluoric acid solution for a period of 30 seconds and rinsed with distilled water. 31 dipped samples were anodized to 180V using a DC rectifier in order to define the design space and analyzed for anatase and rutile using an X-ray diffraction (XRD) thin film technique. After establishing optimal electrolyte mixture needed to produce A/R ratios including max A/min R, max R/min A, 25/75 A/R, and 50/50 A/R, these samples were measured against CPTi and near amorphous oxide layers as controls.

Each oxide ratio was examined for wetting angle, corrosion resistance, and bioactivity in an artificial saliva solution (modified Fusayama's solution). Furthermore, pH adjustments were made to the artificial saliva samples in order to simulate the fluctuations of pH in the oral cavity. It was predicted that lower pH ranges would encourage more rapid corrosion across all categories of oxidized surfaces.

Results: Results showed the lowest wetting angle for max R/min A ratio using artificial saliva. Bioactivity was measured using scanning electron microscopy (SEM) showing earliest growth of apatite crystals on the near amorphous oxide layer. DC corrosion results for the pH varied artificial saliva showed varied results for each oxide layer.

Synthesis, Characterization, and Primary Rat Hepatocyte Culture Studies Atop Charged Elastin-Like-Polypeptide Coatings

***CA Weeks*[1], *AV Janorkar*[1], *SM Kilbey II*[2]

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Objective: Researchers use *in vitro* hepatic culture models both to study liver disease and to screen substances for toxicity. Typical *in vitro* models gauge cellular response of a monolayer of hepatocytes subjected to an experimental condition. However, culture systems that induce hepatic spheroidal aggregates rather than a monolayer have been shown to render cells with metabolism more reflective of *in vivo* hepatocytes. The aim of this research is the synthesis, thorough characterization, and optimization of novel charged elastin-like polypeptide (Charged-ELP) culture substrates to induce and maintain dense populations of highly differentiated hepatic spheroids.

Methods: Genetically modified *E. coli* were cultured to express the elastin-like polypeptide [VPGVG]40. This ELP was conjugated to polyelectrolytes using one of two reaction schemes to render 6 different primary amine-charged ELP conjugates. ELP molecules were either directly conjugated to polyethylenimine, polyarginine, or polylysine; or they were conjugated first to a poly(2-vinyl-4,4-dimethyl azlactone) (PVDMA) linker molecule and subsequently reacted to N-Boc-1,4-butanediamine, N-Boc ethylenediamine, or L-arginine electrolytes. Chemical composition and molecular weights of synthesized Charged-ELPs were assessed using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), Fourier transform infrared (FTIR) spectroscopy, and matrix-assisted laser desorption/ionization time of flight (MALDI TOF) spectroscopy. O-phthalaldehyde (OPA) fluorescence measure of primary amine content within the materials facilitated creation of categories of coating solutions with a range of primary amine content (referred to herein as "charge grades"). Forty-two material/charge grade combination aqueous solutions were solvent cast onto tissue culture polystyrene (TCPS) surfaces for surface analyses including optical microscopy, contact angle goniometry, atomic force microscopy (AFM), and X-ray photoelectron spectroscopy (XPS). We next seeded primary rat hepatocytes atop 2 controls and 22 total Charged-ELP culture surfaces. Cell viability and differentiation over a 20-day period were assessed through optical microscopy and through measurement of total protein, rat albumin, and urea.

Results: SDS-PAGE, MALDI TOF, and FTIR confirmed successful synthesis and molecular weights of our six ELP-PE materials. AFM revealed intricate surface patterns within deposited coatings. Coatings varied in thickness depending on distance from the center. Goniometry revealed no significant differences in coating surface energies upon increasing charge grade or across Charged-ELP material types. Timelapse optical microscopy showed that Charged-ELP surface topography changed significantly for 3 days under culture

conditions. Lower charge grade surfaces generally supported higher cell viability and albumin production. Cultures atop ELP-PEI Grade 1.1, ELP-PVDMA-ethylenediamine Grade 1.7, ELP-poly-lysine Grade 3.4, and ELP-PVDMA-butanediamine grade 1.1 coating yielded the highest albumin production rates on day 20.

Conclusion: Charged-ELP coating formation and resulting surface properties depends on temperature, humidity, coating well size, time immersed in culture media, material type, and primary amine density. Arginine-charged ELPs were ineffective as hepatocyte culture substrates, while lysine-charged coatings rendered cultures with superior cell viability/albumin production combination. PVD-MA-based Charged-ELPs show potential as biocompatible synthetic substitutes for polycationic amino acid molecules and warrant further study. Supported by NSF Award # 1033525.

Research Opportunities and Awards at the University of Mississippi School of Dentistry

Honors in Research Program

The Honors in Research Program (HRP) provides an opportunity for eligible dental students to choose advanced study in dental research or basic health science and receive recognition for their accomplishments on their transcripts and at graduation.

Honors work consists of hypothesis driven research in some aspect of dental or basic health science. Students conduct laboratory research, clinical research, or population research (e.g., improving current clinical practices, exploring controversies in dentistry, engaging in basic and biomedical materials research) with the guidance and supervision of a UMMC faculty member.

Honors in Research Graduates 2009-2014

Kristin Balius, Curtis Caskey, Lacy Harris, Stacey Ritter, Camille Sandifer, Corey Shook, Phebe Winters

School of Dentistry Intramural Research Support Program (IRSP)

The goal of the Intramural Research Support Program is to enhance research activities in the School of Dentistry. In addition to faculty, pre-doctoral students and residents who develop a faculty-mentored research project are eligible to apply for small grants to cover materials and supplies. Priority will be given to those research projects which involve School of Dentistry students.

Student Research Group (SRG)

The School of Dentistry Student Research Group is a branch of the American Association for Dental Research (AADR) National Student Research Group (NSRG) and is composed of dental students committed to research and the advancement of further education. Goals of the organization are to expose dental students to various student research projects, aid in the application process for residencies to dental specialties, and to encourage student participation in dental research. Meetings allow students to share and evaluate on-going research projects within the School of Dentistry including, but not limited to, the following departments: Biomedical Materials Science, Oral-Maxillofacial Surgery and Pathology, and Periodontics and Preventitive Sciences.

Student Research Group Officers for 2014-2015

President, Matt Loeb
Vice-President, Olivia Cook
Treasurer, Susana Ellzey
Secretary, Brannon Myrick
Faculty Advisor, Dr. Jennifer Bain

Awards and Honors

2014 ADA/Dentsply Student Clinician Award – Co-authors, Will Umphlett and Ed Witcher, received the award and represented UMMC at the American Dental Association's Scientific Session in San Antonio, TX, October 9-14, 2014.

2014 Hinman Student Research Award – Co-authors, Olivia Cook and Brannon Myrick, received the award and represented UMMC at the Hinman Student Research Symposium, in Memphis, TN, October 31-November 2, 2014 at the historic Peabody Hotel.

50th Annual Dental Students' Conference on Research – Matt Loeb attended and presented his research, representing UMMC at the ADA Foundation's Volpe Research Center on the NIST campus in Gaithersburg, MD, April 13-15, 2014.

2014 Quintessence Award for Research Achievement – Brice McMurphy received this honor for his combined achievements during his time in the DMD program, including: (1) receiving a Bloc Travel Award in 2010, (2) co-authoring the winning poster for the 2011 Student Clinician Research Award, (3) publishing a peer-reviewed research article in *Dental Materials*, and (4) serving as President of the Student Research Group.

Postdoc Poster Presentation Award – Dr. Susana Salazar presented her research on silica-coating of zirconia ceramic at the Graduate School's Research Day on October 24, 2014, where she won the student research competition.

Silver Medallion for Excellence in Research – Dr. Amol Janorkar was honored with this lifetime achievement award on December 9, 2014. The award recognizes his bringing in more than $500,000 in extramural research funding so far during his appointment at UMMC. Dr. Janorkar's research on tissue engineering scaffolds has been supported by the NSF and the NIH.

Student Research Opportunities at the University of Mississippi School of Dentistry

Undergraduate and Professional Student Training in Advanced Research Techniques (UPSTART) Program

The UPSTART Program provides an opportunity for eligible dental, pre-dental, pre-graduate, and high school students to be involved and trained in research at the University of Mississippi School of Dentistry. The program is designed to initiate students in research by pairing with research mentors, teaching general laboratory safety, and instilling essential research skills through hands-on learning. The research experience is provided under the mentorship of a dental faculty member that is actively engaged in research throughout the summer. The program promotes learning of the dental students as well as the undergraduate students from the local colleges and universities in design and successful implementation of research projects through a didactic seminar series, hands-on laboratory research, and peer-judged research presentations. The students have the opportunity to present their research findings as an oral seminar in the "UPSTART Symposium" organized at the end of the UPSTART program. Additionally, the students are expected to present the research performed during the UPSTART program and progress since then on the following School of Dentistry Research Day. Since its inception, 68 students (31 dental, 37 undergraduate) have benefited from this program.

For information contact:
Dr. Amol V. Janorkar (Email: ajanorkar@umc.edu Phone: 601-984-6170)

UPSTART 2014 Students and Mentors

UPSTART 2013 Students and Mentors

Faculty Excellence in Research (as of July 2014)

bold print signifies an NIH Early Stage Investigator

Cumulative Publications

Rank	Name	Publications
1	Aaron Puckett	93
2	Sigurds Krolls	78
3	Roger Johnson	56
4	Jason Griggs	45
5	**Amol Janorkar**	29
6	James Fitchie	27
7	George Taybos	26
8	Gary Reeves	22
8	**Michael Roach**	22
9	Kenneth St. John	20

Cumulative Hirsch-Index

Rank	Name	H-Index
1	Roger Johnson	14
1	Jason Griggs	14
2	Aaron Puckett	13
3	William Buchanan	10
3	**Amol Janorkar**	10
4	Tracy Dellinger	8
5	Mark Livingston	6
6	**Jennifer Bain**	5
6	Ron Caloss	5
7	Frances Gordy	4

Annual Publications

Rank	Name	Publications
1	Jason Griggs	6
2	**Amol Janorkar**	5
3	**Michael Roach**	4
3	**Ahmad Abdelkarim**	4
4	Kenneth St. John	3
4	**Yuanyuan Duan**	3
5	**Jennifer Bain**	2
5	**Scott Williamson**	2
5	**Denise Krause**	2
5	**Lindsay Montague**	2

Research Student Mentoring

Rank	Name	BS	Grad	DMD
1	**Amol Janorkar**	4	3	5
1	Jason Griggs	1	6	5
2	Aaron Puckett	1	1	4
3	Roger Johnson	0	0	5
3	Steve Pollock	0	0	5
3	**Michael Roach**	0	1	4
4	Ron Caloss	0	0	3
5	**Ravi Chandran**	0	0	2
6	Mitch Hutto	0	0	1
6	Steve Magee	0	0	1
6	Ken St. John	0	1	0

Remembering Research Day 2014...