University of Mississippi Medical Center
School of Dentistry

Research Day 2016

February 23, 2016

David A. Felton, DDS, MS
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
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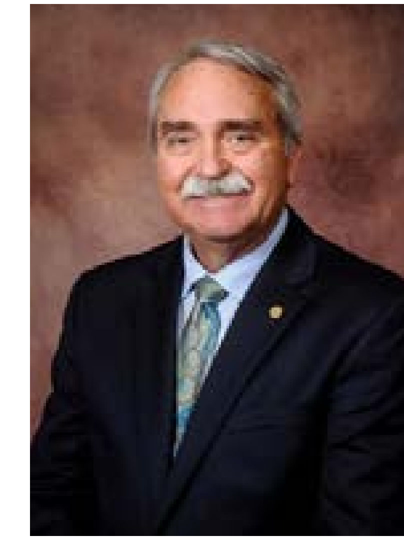
Welcome



Dear Colleagues,

It is indeed a pleasure to welcome you to the 2016 UMMC School of Dentistry Research Day, an annual tradition at the School since 1994!

Today our faculty, students, and post-graduate students come together to present their research findings to the members of the School of Dentistry and our Medical Center colleagues. According to Albert Szent-Gyorgyl, Nobel Prize recipient in Medicine in 1937, "Research is to see what everybody else has seen, and to think what nobody else has thought". Research is critically necessary to advance the science of dentistry and improve patient care and outcomes. Consider the advances that we've seen in dentistry over the past few decades—new dental materials, dental implant therapies, the development of systematic reviews, digital and CAD/CAM dentistry, advances in adhesive dentistry, advances in pulpal and periodontal research, and the movement toward minimally invasive dentistry—the list goes on and on!

Having our students participate in research is an excellent way to advance the science of dentistry beyond the classroom and clinical environment. In addition, according to the Commission on Dental Accreditation (CODA, Standard 6-3), "Dental education programs must provide opportunities, encourage, and support student participation in research and other scholarly activities mentored by faculty." Our faculty continue to serve as excellent mentors and role models for our students in the research arena. As you will witness, the quality of the research presented today strongly supports our goal to not only achieve the CODA accreditation standard, but to surpass it.

Thank you for joining us on this important day in the future of the School of Dentistry, and for your participation in our research activities. I am confident that you will enjoy the posters and oral presentations, and that you will witness, first hand, the ever improving quality of our research initiatives. Enjoy the day!

David A. Felton

David A. Felton, DDS, MS
Dean, School of Dentistry
Professor, Department of Care Planning and Restorative Sciences

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This is an exciting day for the School of Dentistry! It is our first SOD Research Day with our new dean, Dr. David Felton. I am thankful to our retiring dean, Dr. Gary Reeves, for his support of research through intramural seed grants, bridging funds, and travel funds, and I look forward to helping Dr. Felton continue the growth of our research mission.

It is a pleasure to have Dr. Jack Mecholsky with us today as our keynote speaker. I have known Dr. Mecholsky for 24 years. He is passionate about teaching and failure analysis. This enthusiasm and his genial nature attracted me to seek his guidance when I was a student, as it did many other students over the years. Dr. Mecholsky is a distinguished materials scientist, so please take advantage of his visit by asking for advice regarding your current and future projects.

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. John J. Mecholsky, Jr., PhD**
"A Critical Analysis of Fracture or Why Things Fall Apart"

Nelson Student Union Gymnasium

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

Ronald Caloss, DDS, MD
Associate Professor & Chair, Oral-Maxillofacial Surgery & Pathology

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Michael Roach, PhD
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Poster Judges

Ahmad Abdelkarim, DDS, MS, PhD
Assistant Professor & Chair, Orthodontics

Jennifer Bain, DMD, MSPH, PhD
Assistant Professor, Periodontics and Preventitive Sciences

Tina Rushing Woods, DMD
Assistant Professor, Oral-Maxillofacial Surgery & Pathology

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

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Keynote Lecture

"A Critical Analysis of Fracture or Why Things Fall Apart"
John J. Mecholsky, Jr., PhD

Professor
Department of Materials Science & Engineering
University of Florida, Gainesville, FL

Dr. Jack Mecholsky is a Professor at the University of Florida in the Department of Materials Science and Engineering. He served as the Associate Chair from 2005-2010, the Chair of the Faculty Senate in the 2009-2010 academic year and also served on the Board of Trustees for the University of Florida for 2009-2010. He is a Fellow of the American Ceramic Society (ACerS) and served on the Board of Directors of the ACerS from 2006 to 2009.

Dr. Mecholsky is known as an international expert in the fractographic analysis of brittle materials. While on sabbatical leave in 1995-96, he served as the Associate Director for Materials at the Office of Naval Research in London (UK). In 2006 he served as a Guest Researcher at the National Institute for Standards and Technology and in 2013 at the Cavendish Laboratory in Cambridge University. As a recipient of the University of Florida's Faculty Enhancement Opportunity (FEO) award Dr. Mecholsky spent two months at Imperial College in London in 2010 as a visiting researcher. Dr. Mecholsky won the Teacher of the Year Award in 2006 and the Graduate Advisor of the Year Award in 2009.

Prior to 1990 Dr. Mecholsky held a joint appointment at Penn State University in the Materials Science Department as an Associate Professor and as a Research Associate in the U. S. Navy's Advanced Research Laboratory. From 1979-1984 he was a member of the technical staff at Sandia National Laboratories in Albuquerque, New Mexico. Dr. Mecholsky worked at the Naval Research Laboratory in Washington, D.C. from 1972-1979 as a Ceramic Research Engineer, and while finishing his graduate degrees he was a structural research engineer at the Naval Ship Research & Development Center (formerly the David Taylor Model Basin) from 1967-1972. He briefly worked at the Naval Facilities Engineering Command as an Engineer-in-Training from 1966-1967.

Dr. Mecholsky helped design the pressure hull for the Deep Submergence Search Vehicle (DSSV) and the escape hatch for the Deep Submergence Rescue Vehicle (DSRV) shown in the movie "The Hunt for Red October". He developed new fractographic techniques used in the failure analysis of optical fibers, of infrared transmitting radome materials, and of ferroelectrics. He also developed equations for the analysis of failure by laser irradiation of ceramic materials.

Dr. Mecholsky holds patents for the development of a laser hardened composite material and a bioactive tapecast multi-layer ceramic/metal composite. He has published over 200 technical papers and is the co-author of "Fracture of Brittle Materials: Testing and Analysis" (Wiley Pub. 2012).

3D Spheroid Models for Functional Evaluation of Endothelial Cell Differentiation

K Clark[1], *AV Janorkar[1]*

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

Objectives: Establishing angiogenesis is a key factor in regenerative medicine and the future of periodontal tissue engineering. Unfortunately, clinical applications of tissue engineering are limited by the lack of adequate blood supply. Endothelial cells are a vital component of the capillaries that provide adequate blood supply and excretion of wastes in tissues. The main objective of the study was to examine the efficacy of 3D endothelial spheroid culture systems. We hypothesized that human adipose-derived stem cells (hASCs) would more efficiently differentiate toward endothelial lineage when formed as spheroids.

Methods: hASCs isolated from elective liposuction aspirates under an IRB-approved protocol were seeded in varying concentrations of either collagen (2, 6 mg/mL) or collagen-ELP (1:3 mass ratio) hydrogels (40,000 cells/hydrogel). Some hydrogels were cross-linked utilizing carbodiimide chemistry. Cells were cultured in endothelial differentiation medium (EGM-2-MV) and collected on day 0 and 21. Assays for viability, DNA content, total protein content, and for endothelial differentiation markers (von Willebrand factor, CD31, low-density lipoprotein uptake) were performed.

Results: Cells remained viable (>70%) in all hydrogels. Cells cultured in 2 mg/mL collagen and 2:6 collagen-ELP showed spread morphology and proliferated with increase in DNA and protein content. Cells cultured in all other hydrogels revealed spheroidal morphology with either no change (due to contact-inhibited growth arrest) or decrease (due to cell death) in DNA content. Although all hydrogels showed expression of endothelial markers, spheroid formation generally correlated with higher expression.

Conclusions: Our hydrogels support spheroid formation and endothelial cell differentiation, mimicking physiological conditions in which neo-angiogenesis can occur. Conditions displaying higher endothelial marker expression may indicate benefit of spheroid formation. Further studies aim to elucidate how hydrogel stiffness may affect spheroid formation by comparing them against scaffold-free ELP-polyelectrolyte coating that also form spheroids. We will also explore co-culturing strategies to further enhance endothelial differentiation in this new promising approach.

Acknowledgments: Supported by the National Institutes of Health/National Institute of Dental and Craniofacial Research (R03 DE024257).

Modification and Characterization of Anodized Titanium for Dental and Orthopedic Implants

D Lee[1], J Nelson[1], *RS Williamson[1], S Jain[1], AV Janorkar[1], MD Roach[1]*

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

Objectives: Titanium is one of the most commonly used biomaterials for dental and orthopedic implants due to its mechanical properties, corrosion resistance, and excellent biocompatibility. Titanium forms an amorphous oxide layer instantaneously when the surface is exposed to an oxygenated atmosphere. This amorphous oxide layer can then be converted to a crystalline form using an electrochemical process called anodization. Two common crystalline phases of titanium oxide are anatase and rutile which have both been suggested to promote bioactivity and antimicrobial effects. The objective of this research was to determine the phase structure, outermost layer surface chemistry, and the resulting bioactivity of titanium samples anodized using four different acid electrolyte mixtures. Previous studies in our laboratories have shown some of these oxide layers to contain substantial amounts of phosphorus incorporated into the oxide layer. Therefore, a secondary objective was to attempt to also incorporate calcium into the forming oxide layer using a post-anodization soak treatment.

Methods: One-inch square samples machined from commercially pure titanium grade 4 material were prepared with a 1/8th-inch-diameter hole for connection to the anodization rectifier. Anodization was performed using four acid electrolyte mixtures of sulfuric acid, phosphoric acid, oxalic acid, and hydrogen peroxide. X-ray diffraction (XRD) was used to determine the crystalline phase present within the anodized layers. X-ray photoelectron spectroscopy (XPS) was used to determine the outermost layer surface chemistry of the anodized samples. For bioactivity testing, simulated body fluid (SBF) was prepared using standardized guidelines according to the ISO 23317 standard. Bioactivity samples were soaked in 150 milliliters of SBF for periods of 3, 5, and 7 days at 37 °C and analyzed with XRD and SEM/EDS for apatite formation. Anodized samples found to contain phosphorus in the oxide layer were then chosen for calcium uptake testing, and were soaked in 50 mL of 0.6 M calcium nitrate tetrahydrate solution for periods of 48 and 72 hours at 80 °C. Both SBF and calcium soaked samples were viewed using Scanning Electron Microscopy (SEM), and calcium uptake counts were measured using Energy Dispersive X-ray Spectroscopy (EDS).

Results: XRD confirmed the presence of anatase and rutile in varying amounts in the oxide layer depending on the anodization electrolyte utilized. XRD and SEM/EDS showed apatite formation on all anodized samples after 7 days of soaking in SBF. XPS confirmed substantial amounts of phosphorus present in the outermost oxide layer of some of the anodized samples. SEM confirmed the presence of apatite on all of the bioactivity samples after 7 days. EDS showed an increased calcium uptake on phosphorus containing samples with increasing soak time as well as with increasing anodization voltage.

Conclusions: XRD showed the presence of anatase and/or rutile formation for three of the groups with one group having an amorphous oxide layer. The surface oxide layer contained carbon, oxygen, titanium, phosphorous, and traces of sulfur in varying amounts. Lastly, a relationship was found of greater calcium uptake on the phosphorus containing samples with increased anodization voltage and with increased soak time. Future work needs to be performed to increase the calcium and phosphorus ratios to be closer to the 1.67 ratio shown in hydroxyapatite.

Modification and Characterization of Anodized Titanium for Dental and Orthopedic Implants

J Nelson[1], S Jain[1], *RS Williamson[1], AV Janorkar[1], MD Roach[1]*

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

Objectives: Titanium is a desirable dental and orthopedic implant material due to its outstanding mechanical properties and excellent biocompatibility. In an ambient environment in the presence of oxygen, titanium naturally forms a thin amorphous oxide layer. The amorphous layer may be converted to a crystalline oxide form using an electrochemical process such as anodization. Additionally, anodization may be able to incorporate desirable chemical species from the electrolyte into the formed oxide layer. Both anatase (A) and rutile (R) crystalline phases of titanium oxide are known to promote bioactivity and antimicrobial effects. However, it is not currently understood which A/R phase ratio promotes the best results in either or both of these areas. A previous study in our laboratory showed the specific A/R phase ratios within the anodized layers could be controlled using acid electrolyte mixtures. This study resulted in the selection of four acid electrolyte mixtures that were shown to produce specific A/R ratios within the anodized layers. The primary objective of this research was to evaluate the surface morphology, surface chemistry, surface roughness and bioactivity of the oxide layers formed through anodization in sulfuric acid based electrolytes. A secondary objective was to adjunctively incorporate calcium (Ca) into anodized oxide layers that already contained phosphorous (P) in an attempt to obtain a Ca/P ratio similar to apatite.

Methods: The material used for this study was 2-mm-thick commercially pure titanium grade 4 (CPTi-4). An anodization process was completed on all samples with a DC rectifier using potentiostatic 12-V, 10-s steps to a final forming voltage of 180 V. The anodization electrolytes were mixtures of sulfuric acid, phosphoric acid, oxalic acid, and hydrogen peroxide in different molarities. Thin film X-ray diffraction (XRD) was used to determine if anatase and rutile oxide phases were present. Scanning electron microscopy (SEM) was used to examine the oxide layer surface morphology. Image analysis was utilized to identify the total number of pores, individual pore surface area distributions, pore density, mean pore area, and maximum pore area. Surface roughness was measured using atomic force microscopy (AFM) with ScanAssyst mode. Surface chemistry was determined for each of the anodized groups using energy dispersive X-ray spectroscopy (EDS). Bioactivity testing in simulated body fluid (SBF), prepared using ISO Standard 23317 guidelines, was performed by submerging samples for periods of 3, 5, and 7 days at 37 °C. Samples were then rinsed and dried overnight to be analyzed the following day. XRD and SEM/EDS were used to detect the presence of apatite on the surface for each condition. Samples shown to contain phosphorus in the EDS analysis of the formed oxide were then soaked in 50 mL of a 0.6 M calcium nitrate tetrahydrate solution at 80 °C for periods of 48 or 72 hours, dried overnight, and analyzed the next day. The weight percent P present and the amount of Ca uptake was measured using EDS.

Results: XRD results showed that anatase and rutile formation was electrolyte dependent. Surface morphology results showed that the surface pore size and distribution were also functions of the anodization electrolyte used. Three electrolyte groups showed mainly round pores at higher forming voltages, while the fourth group showed elongated pores. AFM scans showed significant differences in the surface roughness (Ra) values between the anodized groups, but all samples exhibited an Ra value less than 1 μm. EDS results revealed the presence of P within the oxide layers of the samples anodized with an electrolyte mixtures that contained phosphoric acid. The amount of P was found to increase with the increase of phosphoric acid molarity within the electrolyte solution. XRD and SEM/EDS revealed successful apatite formation at 7 days for all anodized samples from each electrolyte mixture. Ca was also successfully incorporated into the surface of samples shown to contain P using a soaking time of 72 hours. The anodized samples with the higher initial P content also showed the highest Ca uptake.

Conclusions: The surface oxide crystallinity and morphology were found to be dependent on the anodization electrolyte mixture utilized at a forming voltage of 180 V. The surface roughness values were found to be sub-micron for all groups. Samples with P in the surface oxide were also able to incorporate Ca, however at a Ca/P ratio less than the desired ratio of 1.67 found within apatite. The detailed understanding of the surface porosity and Ca uptake of each of these anodized samples is anticipated to provide valuable insight for future antimicrobial, bioactivity, and osseointegration testing of implant materials.

Finite Element Analysis of Maxillary Prosthesis Supported by Zygomatic Implants

E Theilman[1,2], *R Chandran*[2], *Y Duan*[1]*

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center; [2]Department of Oral-Maxillofacial Surgery and Pathology, University of Mississippi Medical Center

Objectives: To create 3D composite models of Quad zygomatic implant-supported maxillary prosthesis, simulate a variety of additional bone defects around zygomatic implants and investigate the stress distribution in the surrounding bone structures using finite element analysis (FEA).

Methods: One commercial zygomatic implant system (Zygoma Machined, Nobel Biocare) and one conventional dental implant system (Bone Level, Straumann) were scanned using an X-ray micro-CT scanner (Skyscan1172, Skyscan). A standardized sawbone human skull model was scanned using a cone-beam CT scanner (i-CAT, Imaging Sciences International). CT scanning images were imported into a medical image processing software (Mimics X64, Materialise). 3D models of zygomatic and dental implants, maxillary prosthesis and surrounding bone were created and assembled in Mimics. A variety of additional bone defects were created at the locations of four zygomatic implants to simulate possible clinical scenarios listed in following table. The solid volume mesh files were created and exported into a commercial FEA software (ABAQUS, Dassault Systems). Material properties were assigned for all the structures, and stress distribution results were collected in the post-processing module.

Model ID	Location of bone defects
1	Additional defects on all four implants
2	Additional defects on 3/4 implants
3	Additional defects on 2 anterior implants
4	Additional defects on 2 posterior implants
5	Additional defects on contralateral implants
6	Additional defect on one anterior implant
7	Additional defect on one posterior implant

Results: The highest von Mises stress was found in Model 1, and the lowest stress was found in Model 7. The peak stress concentration in the bone structure was adjacent to the interface area between zygomatic bone and implant body. Generally, there was an increase of peak stress value with the number of additional bone defects, while the anterior defects caused a larger stress increase compared to the posterior ones.

Conclusions: Additional bone defects will increase the stress concentration in the surrounding area. More care should be given if these additional bone defects are around the anterior zygomatic implants.

Upper Airway Volumetric Analysis Utilizing Dolphin Imaging

J Collins[1], ***R Young***[1], *R Caloss*[2], *H Price*[2]

[1]Department of Biomedical Materials Science, University of Mississippi Medical Center; [2]Department of Oral-Maxillofacial Surgery and Pathology, University of Mississippi Medical Center

Objectives: The primary purpose of this study was to assess the accuracy of Dolphin Imaging's semi-automatic tool for segmenting airway phantoms scanned with cone beam computed tomography (CBCT). Secondarily, it was to assess the intra- and inter-observer variability among dental professionals of differing experience levels.

Methods: Three phantom airways of differing diameters and of known volumes were fabricated to simulate upper airway and neck anatomy. The actual airway volumes were determined by water weight measurements. Phantoms were scanned with an iCAT CBCT. Volumetric analysis of each reconstructed airway was performed with Dolphin Imaging (DI) in order to assess accuracy of the software. CBCT digital imaging and communications in medicine (DICOM) data were entered into DI. DI has a semi-automatic tool that allows segmentation and volumetric measurement of the airway structure. Twenty patients were then randomly selected from the University of Mississippi Medical Center, Department of Oral and Maxillofacial Surgery (OMS) DI database. Patients previously had a CBCT performed for evaluation of a dentofacial deformity. Patient exclusion criteria included obstructive sleep apnea and craniofacial deformities such as cleft lip/palate. Patient DICOM data were entered into DI. Airways were segmented from the level of the hard palate to the superior aspect of the 4th cervical vertebra. Airway segmentation and volumetric measurements were performed in the same fashion as done for the phantoms. Examiners with different levels of experience performed the airway analysis to assess inter-observer variability and at three different time points to assess intra-observer variability. Examiners included a 1st year dental student, a 3rd year dental student, an OMS 3rd year resident and an OMS attending surgeon. All assessments were performed using the same desktop computer and monitor. Data were compiled on an Excel spreadsheet for analysis. Linear regression analysis was used to assess the precision and accuracy of the volumetric analysis of the phantom airways. Two-Way Repeated Measures ANOVA (Two Factor Repetition) was used to assess intra- and inter-observer sources of variation.

Poster Abstracts
Bold print signifies student researcher
*signifies presenter if not first author

Results: The examiners' accuracy and precision fell within a 95% confidence interval of the actual phantom airway volumes. Interestingly, precision did not improve over time. Significant inter-observer variability was noted for each data set and each time point ($p < 0.001$). Significant intra-observer variability occurred for three of the four examiners ($p = 0.012$). Variability did not decrease with time.

Conclusions: DI software was accurate and precise in assessing airway volume in the simulated phantom airways used in this study. Significant inter- and intra-observer variability was present. DI seems to be a suitable tool to perform volumetric airway analysis clinically. Future studies might test accuracy of other commercially available software programs as well as more anatomically complex phantom airways.

Arteriovenous Malformation of the Mandible Treated with Endovascular Embolization with Platinum Coils and ONYX 18

H Price[1], *R Chandran*[1]

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

Objectives: Arteriovenous malformations (AVM) of the mandible are rare, and also can be potentially life threatening due to massive hemorrhage. These lesions have been treated by multiple modalities including endovascular embolization, direct intralesional embolization, or surgical resection. The objective of this case presentation is to document the efficacy of endovascular embolization with platinum coils and ONYX 18 for the treatment of an AMV of the mandible.

Methods: This was the case of an 18 year-old female with an AVM of the right mandible who presented after massive hemorrhage following dental extractions. She successfully underwent endovascular embolization with platinum coils and ONYX 18. A repeat diagnostic angiogram was obtained 27 months after the initial embolization procedure.

Results: Complete occlusion of the AVM via endovascular embolization with platinum coils and ONYX 18. The repeat diagnostic angiogram obtained 27 months after initial embolization procedure showed evidence of vascular blush in the right mandibular body region representing mild residual of the lesion. No obvious recurrence of the lesion noted.

Conclusions: Endovascular embolization with platinum coils and ONYX 18 was used to completely occlude the AMV of the mandible. No obvious recurrence of the lesion was noted at 27 months, however some residual blushing was noted in the right mandibular body region. Continued follow up with a repeat angiogram is recommended to evaluate for any changes versus stability of the lesion.

Spheroid Model for Functional Osteogenic Evaluation of Human Adipose Derived Stem Cells

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

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

Objectives: Three dimensional (3D) spheroids of bone cells allow better cellular interactions contributing to cell differentiation towards osteogenic lineage than the current two dimensional (2D) monolayer cell culture. The main objective of this study was to form an *in vitro* 3D osteogenic cell culture model from human adipose derived stem cells (hASCs) using a conjugate of a recombinant protein, elastin-like polypeptide (ELP), with a charged polyelectrolyte, polyethyleneimine (PEI). With our previous studies showing successful spheroid evaluations of proliferation and differentiation in 3T3-L1 adipocytes and H35 rat hepatoma, we hypothesized that hASCs cultured as 3D spheroids would differentiate more toward osteoblastic lineage when compared to the traditional 2D monolayer.

Methods: ELP expression, purification and chemical modification with PEI and its coating atop tissue culture polystyrene (TCPS) surface were performed. hASCs isolated from elective liposuction aspirates under an IRB-approved protocol were seeded onto uncoated and ELP-PEI coated TCPS surfaces of 24-well cell culture plates and cultured for 3 days of acclimation followed by supplementation with osteogenic cocktail for 3 weeks. Live/Dead assay, BCA total protein assay, alkaline phosphatase activity (ALP), osteocalcin, and alizarin red staining were performed using manufacturers' protocols. Statistical evaluation was performed with ANOVA and Games-Howell *post hoc* test.

Results: hASCs displayed monolayer features during acclimation on uncoated TCPS surface while ELP-PEI surface showed cell aggregates during the first 24 h and formed spheroids later. Live/Dead assay showed a high number of live cells on coated and uncoated TCPS surfaces (> 90%) on day 23. The total protein content had an increasing trend in 2D monolayer indicating cells were metabolically active and proliferating. However, the 3D spheroids showed early plateau in total protein content values, which was due to contact inhibited growth arrest. The ALP activity and osteocalcin normalized to total protein content were greater on days 8, 15 and 22 for 3D spheroids than 2D monolayer indicating higher differentiation of hASCs into osteoblastic lineage. Alizarin red staining on day 23 showed a negligible amount of mineralization in 2D monolayer while the 3D spheroids had greater staining indicating higher mineralization activity. Significant statistical differences were seen between 3D spheroids and 2D monolayer in ALP activity, osteocalcin, and mineralization indicating differences in cellular response to ELP-PEI coated and uncoated TCPS surfaces.

Conclusions: Osteogenic differentiation, maturation, and mineralization were considerably greater in 3D spheroids formed using hASCs cultured atop ELP-PEI coated surfaces than the 2D monolayer formed on uncoated surfaces indicating 3D spheroids to be a better culture technique. 3D *in vitro* culture of osteogenic cells may serve as an alternative to 2D culture by providing better understanding of cellular functions and interactions in bone tissue engineering.

Acknowledgments: Supported by the National Institutes of Health/ National Institute of Dental and Craniofacial Research (R03 DE024257).

Forming Voltage and Crystalline Phase Effects on Bioactivity and Shear Strength of Anodized Titanium

***S Jain*[1]**, *RS Williamson*[1], *MD Roach*[1]

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

Objectives: Titanium is widely used as a dental implant material due to its good mechanical properties and excellent biocompatibility. Recently a number of surface modification techniques have been developed to form a thick, microrough and porous oxide layer with anatase or rutile crystalline phases of titanium oxide. Both anatase and rutile are known to promote bioactivity and antimicrobial effects. Recent studies have suggested that the forming voltage, oxide thickness and surface morphology of the oxide layer individually and combined may contribute towards the apatite inducing ability as well as the resulting shear strength of the formed oxide layer. The objectives of our current research were to determine the bioactivity and shear strength of the anodized samples as a function of crystalline phase, surface morphology and oxide layer thickness with increasing forming voltage.

Methods: Commercially pure titanium grade 4 samples (1 in^2) were fabricated from a 2.00-mm sheet and were anodized using potentiostatic 12-V steps for 10 seconds per step in electrolyte mixtures of sulfuric acid, phosphoric acid, oxalic acid, and hydrogen peroxide. Samples were analyzed for the crystalline phases present in the formed oxide layer using thin film X-ray diffraction (XRD). Scanning electron microscopy (SEM) was used to determine the surface morphology and oxide layer thickness. For testing bioactivity, or apatite inducing ability, simulated body fluid (SBF) was prepared using standard ISO 23317 guidelines. The samples formed were soaked in 150 mL of SBF at 37 °C for 5, 7, 14 and 28 days. Shear strength was determined using ASTM F1044-05 standard testing method wherein samples anodized to different forming voltages and uncoated control samples were bonded together using 3M DP420 epoxy glue, and the whole assembly was subjected to a tensile load applied at a controlled rate.

Results: XRD confirmed the presence of anatase and rutile crystalline phases in varying ratios depending on the electrolyte mixture used for anodization and the forming voltage applied. An exponential increase in the thickness of the oxide layer was shown with increasing forming voltage. Surface morphology showed formation of a number of small pores once a threshold voltage had been reached. Pore size increased with increasing forming voltages. Apatite formation was detected for all the anodized samples within 28 days but the initiation time for apatite formation varied depending on the oxide phase, surface morphology and forming voltage. Shear strength was shown to decrease with increasing porosity at higher forming voltages. At even higher forming voltages, cracking of the anodized layer began to appear and led to a further significant decrease in shear strength.

Conclusions: Both the bioactivity and the shear strength of anodized Ti varied with forming voltage, surface morphology, oxide layer thickness and the crystalline phase present. All samples showed apatite formation within 28 days. Shear strength was dependent both on the thickness of the oxide layer as well as the size and number of pores present on the surface. This detailed understanding of the bioactivity and shear strength of the anodized layers will provide valuable insights for selecting the conditions needed to produce optimized test samples for future antimicrobial and osseointegration studies.

A New Approach to Modify the Cementation Surfaces of Zirconia Structures: Fatigue Lifetime

***SM Salazar Marocho*[1,2]**, *DS Manarão*[1], *PF Cesar*[1], *JA Griggs*[2]

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

Objectives: To predict the fatigue lifetime of an yttrium stabilized zirconia polycrystalline (Y- TZP) ceramic after different silica-coating (SC) protocols.

Methods: Y-TZP bar-shaped specimens (1.2 x 4.0 x 25.0 mm) were divided according to the different SC protocols (n=30). The control group a) did not receive any surface treatment. Groups b) and c) were SC with 30 µm silica-modified alumina particles before and after final sintering, respectively. Specimens were subjected to a four-point bending strep-stress fatigue test at a cyclic load frequency of 2 Hz. The fatigue stress in each step was increased every 65,800 cycles for the mild profile, every 43,200 cycles for the moderate profile, and every 22,600 cycles for the severe profile. The number of cycles to failure was recorded, and the probability of failure was calculated at tensile stresses induced during normal function (30 MPa) and parafunction (110 MPa).

Results: The results showed that the average lifetime for each profile decreased as the tensile stresses in each step increased. The probability of failure (%) at functional and parafunctional tensile stresses, considering missions of 1,000,000 cycles, 3,000,000, and 5,000,000 cycles (which correspond to 1, 3 and 5 years in service, respectively), varied from 0 to 1%.

Conclusions: The surface modification produced by SC before or after the final sintering did not affect the reliability of the Y-TZP structures up to 5 years, regardless of the tensile stress (functional and parafunctional).

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Oral Cancer in Mississippi: Prevalence, Severity and Disparities

***D Patel*[1]**, *DD Krause*[2]

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Objectives: The aim of this research was to examine the prevalence and severity of oral cancer in Mississippi, and to determine whether socio-demographic disparities exist.

Methods: Socio-demographic data were obtained from the U.S. Census 2010 (U.S. Census Bureau, 2010). Variables of interest include gender, race, and socioeconomic factors. Tableau Desktop software was used to create filled map visualizations of population socio-demographic data. Data were also obtained from the University of Mississippi Medical Center (UMMC) Head and Neck Cancer database of all oral cancer cases seen at UMMC from 2002-2015. For this study, we defined oral cancer as cancers of the oral cavity, larynx, hypopharynx, oropharynx, nasopharynx, and the paranasal sinus. These data were used to create visualizations showing the distribution of oral cancer cases in Mississippi aggregated to the zip code level. All of these visualizations were then used to determine relationships between oral cancer prevalence, types and severity, and socioeconomic factors. Visualizations were also used to see if there were any disparities in age, race, gender, and/or geography.

Results: From 2002-2015, 391 cases of oral cancer were recorded at UMMC – 124 women and 267 men. The ratio of men to women was almost 2:1, which is consistent with the data from the Oral Cancer Foundation. Research studies have shown that this may be attributed to men being more likely to engage in risky behaviors than women. The number of Caucasians in the UMMC head and neck cancer database who have oral cancer compared to African Americans was surprising. We found that 217 of the oral cancer cases were Caucasians compared to 149 African Americans. Literature has repeatedly shown that the incidence rate of oral cancer is higher in the African American population due to a general lower socioeconomic status. Not surprisingly, Stage 4 cases have the highest number of deaths (166) in this database. Examining the data, it was evident that Stage 4 was the most commonly diagnosed stage, and males were much more likely to present at later stages than females. This finding agrees with existing literature and is somewhat understandable because at its early stages oral cancer is painless and symptom free.

Conclusions: Oral cancer is a relentless and debilitating cancer. Although advances have been made to understand and treat oral cancer, it continues to be diagnosed at advanced stages. Thus, outcomes and survival rates remain poor. Our results corroborate this assertion, showing Stage 4 as the most commonly diagnosed stage with the highest death rate among our sample. This study provides valuable information in the form of data visualizations of the prevalence, severity, and disparities of oral cancer cases in Mississippi.

Examining Medicaid Claims Utilization Patterns by Dental Patients

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Objectives: The purpose of this study was to examine the Medicaid claims utilization patterns of dental patients in Mississippi and to determine whether any disparities in utilization exist according to age, geographic location, procedure, and poverty. In order to achieve our objective, we tested the following hypotheses:

- Medicaid utilization is higher in urban areas of Mississippi than rural areas of Mississippi.
- Medicaid utilization in Mississippi is higher for children than adults.
- Medicaid participants, both children and adults, use oral health care services for restorative treatment more often than for preventive treatment.

Methods: Socio-demographic data for Mississippi were collected from the United States Census Bureau American FactFinder at the zip code level. Data included age and race demographics, gender, median household income, educational attainment, employment status, poverty status, and health insurance utilization. These data were then processed and accessed with Tableau Desktop Software to create filled map visualizations, graphs, and charts. We obtained dental claims utilization data from the Mississippi Division of Medicaid for years 2007-2014. There were 64,981 claim records broken down by type of procedure with no identifiers about the provider except zip code of practice location. We further aggregated the claims data to the county level for some analyses. Dental licensure data were obtained from the Mississippi State Board of Dental Examiners. Using the Medicaid claims data and urban/rural data from the United States Census Bureau American FactFinder, we mapped the total number of Medicaid dental claims for all zip codes, classifying zip code areas as either rural, urban area, or urban cluster. Finally, the blended datasets were used to create data visualizations and dynamic dashboards representing Medicaid dental utilization data for Mississippi.

Results: The data visualizations that were created revealed that most Medicaid reimbursements were made in urban areas, the most heavily populated of the three classifications. In contrast, the least amounts of Medicaid reimbursements were made in rural areas, the least populated area of the three classifications. Based on the Medicaid claims data, more Medicaid claims were made by children 1 to 18 than were made by adults 19 and older. Nearly $500,000,000 in Medicaid reimbursements were made for children's dental procedures, and only around $70,000,000 in Medicaid reimbursements were made for adults' dental procedures. More dental patients covered by Medicaid received restorative treatment than received preventive treatment. Nearly 84% of reimbursements were made for restorative care for both children and adults; whereas, only 16% of reimbursements were made for preventive care. Of that 16%, children received nearly 99% of all preventive care, while adults only received 1% of preventive care.

Conclusions: The next steps are to use the socioeconomic data obtained from the U.S. Census Bureau American FactFinder and Medicaid dental claims data to determine whether disparities exist in patient utilization based on ethnicity and gender. We also plan to find which dental practices in Mississippi accept Medicaid and which ones do not to determine where geographic disparities in access to care based may exist.

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 2009-2015

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 2015-2016

President – Joe Collins
Vice-President – Alisha Li
Treasurer – Anna Nix
Secretary – Bryant Salmon
Faculty Advisor – Dr. Jennifer Bain

Awards and Honors

2015 ADA/Dentsply Student Clinician Award – Niketa Thompson was the ADA/Dentsply Student Clinician Award winner and was presented the award at Student Awards Day 2015.

2015 Hinman Student Research Award – Co-authors, Bryant Salmon and Will Fontaine, received this award and represented UMMC at the Hinman Student Research Symposium, in Memphis, TN, October 30 - November 1, 2015 at the historic Peabody Hotel.

51st Annual Colgate Dental Students' Conference on Research Jiman Nelson was selected as UMMC's representative to attend this conference, which introduces outstanding dental students to scientists from the ADA Foundation's Dr. Anthony Volpe Research Center on the NIST campus in Gaithersburg, MD. The conference was held on October 25-27, 2015.

2015 Quintessence Award for Research Achievement – Suzanna Ellzey Nida received this honor for her many combined achievements during her time in the DMD program, including: (1) Representing UMMC at the Annual Colgate Dental Students' Conference on Research in 2013, (2) Making an oral presentation at the Mississippi Academy of Sciences in 2013 and (3) Serving as Treasurer of the Student Research Group for 2014-15.

2015 Paffenbarger Research Award – Sakshi Jain, a Biomedical Materials Science Master's degree student competed as a finalist for the Paffenbarger Research Award at the Academy of Dental Materials Conference. She gave an oral presentation of her research and was selected fourth place. Sakshi's abstract was entitled, "Growth of Crystalline Titanium Oxide Films in Different Acid Electrolytes."

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 who 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, 79 students (36 dental, 43 other) have benefited from this program.

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

UPSTART 2015 Students and Mentors with Dr. Reeves

Faculty Excellence in Research (as of December 31, 2015)

Bold print signifies an NIH Early Stage Investigator

Cumulative Publications

Rank	Name	Publications
1	David Felton	109
2	Aaron Puckett	96
3	Jason Griggs	51
4	Amol Janorkar	36
5	**Yuanyuan Duan**	34
6	James Fitchie	27
7	**Michael Roach**	24
8	Kenneth St. John	22
9	**Niping Wang**	21
10	William Buchanan	19
10	Tracy Dellinger	19

Cumulative Hirsch-Index

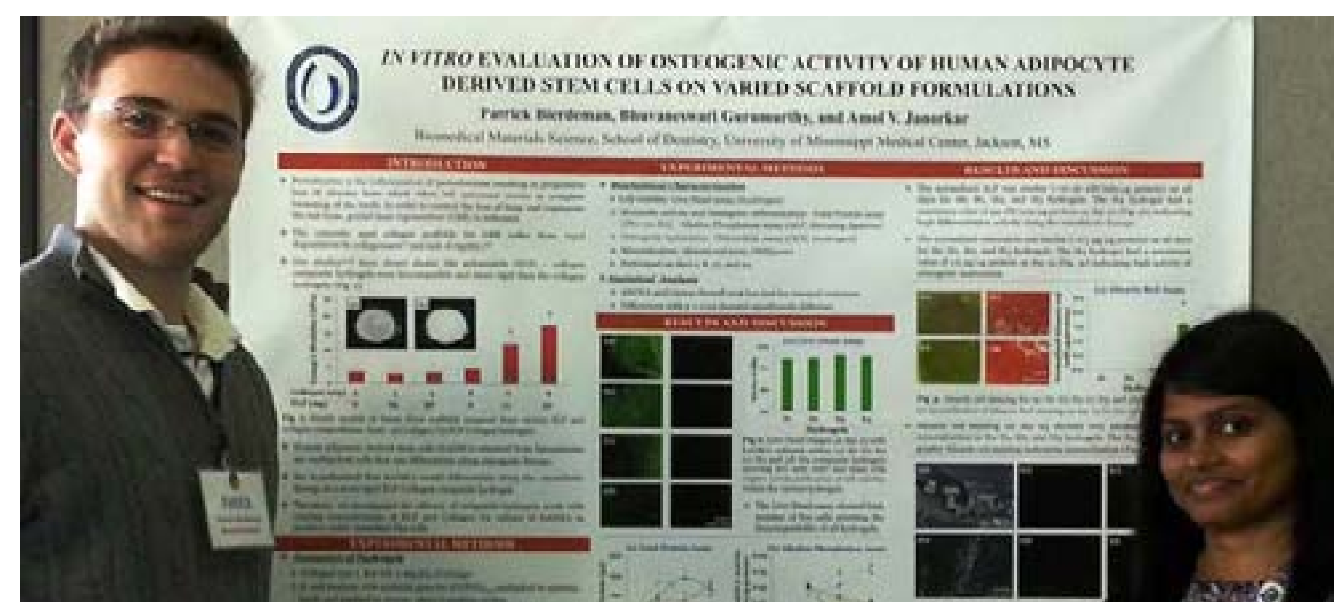
Rank	Name	H-Index
1	David Felton	25
2	Aaron Puckett	18
3	Jason Griggs	16
4	William Buchanan	11
4	Amol Janorkar	11
5	Tracy Dellinger	8
6	James Fitchie	7
6	Mark Livingston	7
6	Kenneth St. John	7
6	**Niping Wang**	7

Annual Publications

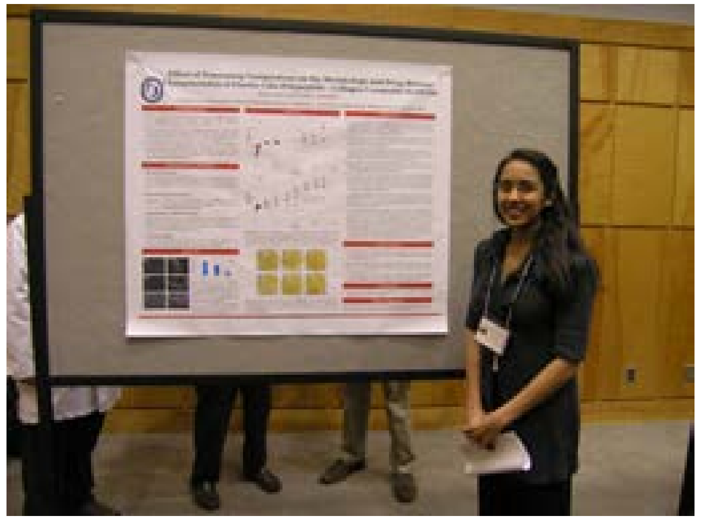
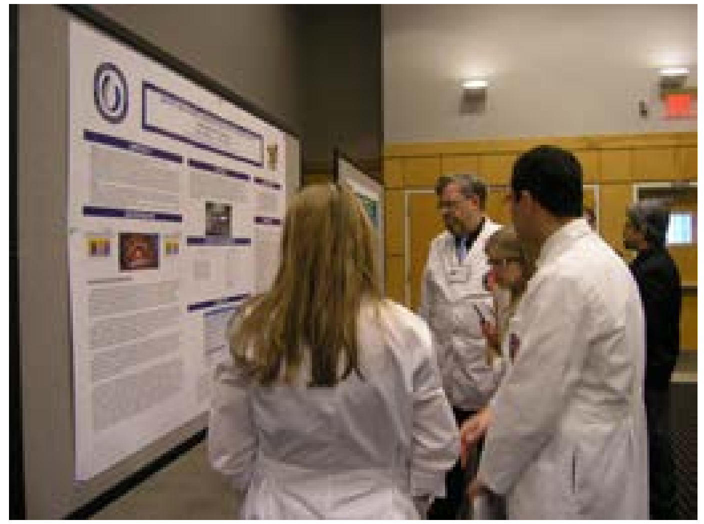
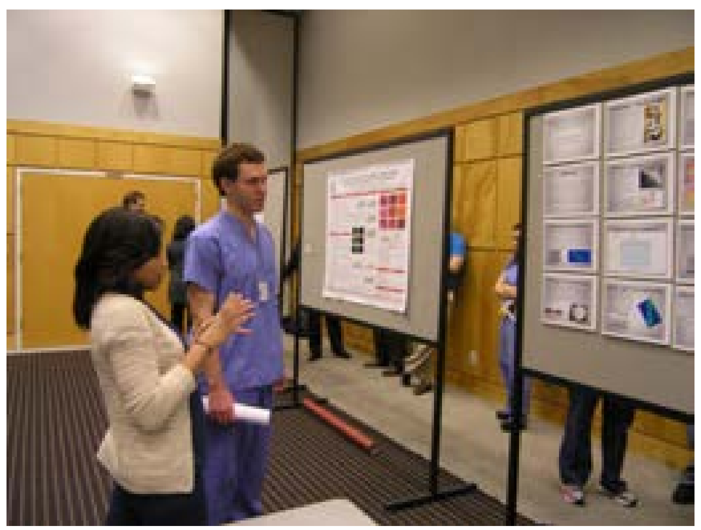
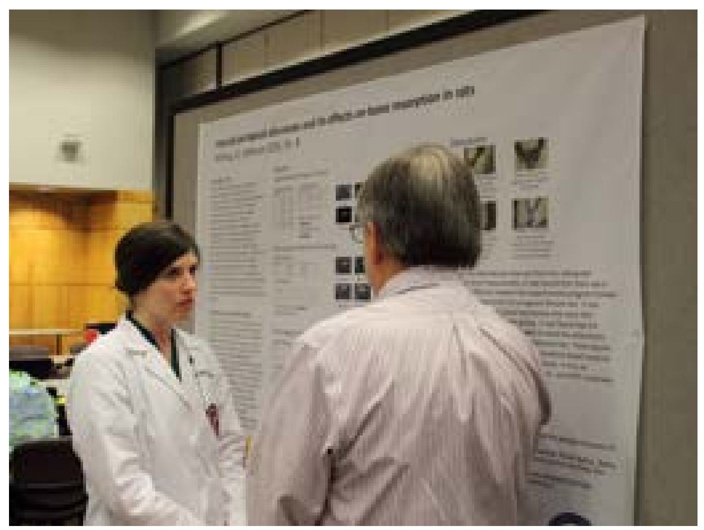
Rank	Name	Publications
1	Jason Griggs	6
2	**Ahmad Abdelkarim**	4
3	**Yuanyuan Duan**	3
3	Amol Janorkar	3
4	**Lindsay Montague**	2
4	Aaron Puckett	2
4	**Michael Roach**	2
5	Roland Adams	1
5	**Jennifer Bain**	1
5	David Felton	1
5	**Denise Krause**	1
5	Mohammed K. Qaisi	1
5	**Tina R. Woods**	1
5	**Scott Williamson**	1

UPSTART Student Mentoring

Rank	Name	BS	Grad	DMD
1	Amol Janorkar	4	4	8
2	Jason Griggs	1	7	5
3	**Michael Roach**	0	2	6
4	Ron Caloss	0	1	5
4	Aaron Puckett	1	1	4
6	**Ravi Chandran**	0	0	4
6	**Denise Krause**	2	1	1
7	**Scott Williamson**	0	1	2
8	**Ahmad Abdelkarim**	0	1	0
8	**Yuanyuan Duan**	0	0	1
8	Mitch Hutto	0	0	1
8	Steve Magee	0	0	1
8	Kenneth St. John	0	1	0



Previous Research Days...

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