

## **2019 Advanced Prosthodontics Science Day**

### **Case Reports**

1. Benjamin Rosenbaum (Dr. Chung)

*The Scleroderma Patient*

Scleroderma is an autoimmune connective tissue disease that primarily affects connective tissues. Its manifestations are systemic, however, there are profound oral symptoms that complicate comprehensive dental treatment. Changes to routine techniques facilitate successful treatment can be utilized for clinician effectiveness and patient satisfaction. This case presentation shows examples of multiple patients, with varying degrees of severity in their scleroderma, that completed comprehensive dental treatments.

2. Faraz Tavoossi (Dr. Chung)

*Dental Management of a Hemophilia Patient: A Case Report*

Hemophilia is an X-linked recessive inherited bleeding disorder in which blood does not clot properly due to insufficient clotting factors. There are two main types: hemophilia A, a deficiency in factor VIII and hemophilia B, a deficiency in factor IX. The incidence is 1:5000 and 1:30000 live male births for hemophilia A and B, respectively. Due to high bleeding risks associated with this disorder, dentists face challenges with respect to the dental management of these patients. In this case report, we will outline various considerations for dental management of a patient recently treated at the UCLA Hospital Dentistry Clinic.

3. Theodore Tso (Dr. Jayanetti)

*Real Time Navigation Surgery for Placement of Zygomatic Implants to Retain a Nasal Prosthesis*

Prosthetic treatment of a patient presenting with a total rhinectomy is described. Adhesive retained prosthesis use was unsatisfactory due to excessive lacrimal gland secretion and hypersensitivity to silicone adhesive. Irradiation of the nasal floor precluded placement of implants in the region so zygomatic bones were utilized. Due to patient hesitation for further surgery and risk of visible scars, a guided approach using CT imaging and real time navigation surgery was utilized. Two zygomatic implants were placed and provisionally restored with a bar retained nasal prosthesis. The method of surgery allows temporary restoration of the cosmetic defect in a timely fashion

4. Nuntaporn Rojanasakul (Dr. Jayanetti)

*Prosthetic rehabilitation of extensive lower facial defect: case report*

67-year-old male patient with extensive lower facial defect presented with a chief complaint of a parched and exposed tongue, unintelligible speech, and appearance issue. Patient had a history of squamous cell carcinoma of the lower lip, S/P Mohs surgery, recurrences and multiple resections, chemo and radiotherapy, osteoradionecrosis and multiple failed attempts of surgical reconstruction. The defect involved nearly the entire mandible and all associated myocutaneous tissues of the lower facial third. An oral and facial prosthesis, fabricated employing conventional and digital technologies. The patient and wife report an improvement in quality of life.

## Clinical Research

### 5. Sonika Himani (Dr. Chung)

#### *The Correlation between Patients' Functional Level and Medications Needed for IV Moderate Sedation*

Sedation is often needed to treat special needs patients' dental needs. However, it can be challenging to discern which patients can be treated with intravenous moderate sedation (IVMS) in the dental office versus general anesthesia (GA) in the operating room (OR). An assessment questionnaire was developed to see if patients could be more objectively assessed to better predict which patients could be treated in the dental office with IVMS versus GA in the OR. The results of the study showed a direct correlation with the amount of sedation medications used in IVMS and patients' functional score, based on this questionnaire.

### 6. Sonia Soto (Dr. Chung)

#### *The Use of SDF in the Management of Cervical Caries in Post Radiation and Medically Complex Patient*

Silver diamine fluoride (SDF) is a topical medicament used for the treatment of dentinal hypersensitivity as well as to prevent dental decay from progressing. Although SDF is currently broadly used in pediatric populations, applications can be extended in other populations such as those who have previously received radiation or have other medical complexities. These populations tend to be susceptible to rampant decay, in particular, root caries. It is hoped that these case reports will inform practitioners about the caries management practices and aid in formulating clinical management protocols in these vulnerable population.

### 7. Crystal Lee, DDS and Reeva Mincer, DDS (Dr. Chung)

#### *Dexmedetomidine reduces the amount of benzodiazepines and opioids administered during moderate conscious sedation for dental treatment.*

The use of dexmedetomidine in addition to routine medications during IV moderate sedation should reduce the overall medication along with reduction of risks of usual sedation medications (Benzodiazepines and Opioids). In the SPC clinic, 24 patients were seen with and without dexmedetomidine for dental care. The medications used along with vital signs and complications were recorded at 5 minute intervals. The cumulative amount of benzodiazepines and opioids administered during IVCS with dexmedetomidine was significantly reduced ( $P=0.007$ ). There were no complications noted. Dexmedetomidine is a safe adjuvant medication for IV sedation.

### 8. Heidi Kim (Dr. Zahr)

#### *Oral Health and occlusal Manifestations in Patients with Osteogenesis Imperfecta*

Osteogenesis imperfecta (OI) is a genetic connective tissue disorder characterized by skeletal abnormalities that can cause bone fractures. The study is aimed to increase the awareness of dentinogenesis imperfecta (DI) in patients with OI and to evaluate factors related to their oral health and malocclusion. A cross-sectional observational study was completed at the UCLA Hospital Dentistry Clinic and data was collected from 44 patients with OI. The number of filled, defective teeth, plaque index, and occlusion class, presence of anterior and lateral open bite were recorded. These findings were correlated to the type of OI and the presence of DI.

## Basic Science

### 9. Patrick Minassians (Dr. Wu)

#### *Evaluating the effect of formulation conditions on NELL-1 thermal stability for future clinical applications as anti-osteoporotic agent*

Osteoporosis is a condition characterized by loss of bone density that afflicts over 200 million individuals worldwide. NELL-1 is a protein of interest for its potential to treat osteoporosis by regenerating bone as an osteoinductive growth factor. This study focuses on the continued effort to analyze and promote the preservation of NELL-1 conformation during exposure to various temperatures and formulation conditions through the addition of excipients. By implementing changes to storage and processing protocols according to finding that mannitol can protect NELL-1 via hydrogen bond interactions, NELL-1 can be implemented effectively in clinical applications as an agent against osteoporosis.

### 10. Max Zhu (Dr. Wu)

#### *Droplet Formation of Polyethylene Glycol Based Bioinks*

3D printing of biomaterials has allowed for increased control over spatial resolution of these materials and the complexity of structures formed. The Wu Lab has previously developed several polyethylene glycol based bioink formulations that can be polymerized into solid structures upon exposure to visible light. These bioinks can be used for various biomedical applications, such as drug delivery vehicles, membrane synthesis, or bioscaffold formation. However, the properties of droplet formation must first be characterized to achieve these goals. This study describes the effects of chemical formulation, temperature, and voltage on the size and kinetics of droplets formed.

### 11. Jisi Zheng (Dr. Wu)

#### *Fused Deposition Modelling 3D printing of high temperature polymers: WMCNTs-PEEK composites*

Poly-ether-ether- ketone (PEEK) exhibits excellent mechanical properties and chemical stabilities; it has been used widely in medical applications. However, the enhanced PEEK composites have been studied to make it stronger for Joint prosthesis. This study examined the mechanical behaviors of multi-walled carbon nanotubes (WMCNTs) dispersion on PEEK. The tensile strength, flexible strength, hardness and microstructure of PEEK and WMCNTs-PEEK samples were investigated throughout the three steps: compounded composite, fabricated filaments, 3D printed test specimens. The results showed that the mechanical property of WMCNTs-PEEK is higher than the PEEK samples, which may lead to the success for joint prosthesis fabrication.

### 12. Chen Chen (Dr. Lee)

#### *Trb3 Enhances Osteogenic Differentiation of Mesenchymal Stem Cells*

Stimulation of osteoblast differentiation from mesenchymal stem cells (MSCs) is a promising strategy for damaged bone repair. Here, we report that tribbles homolog 3 (Trb3) is a novel osteoinductive stimulator for MSC osteogenesis. Our results showed that up-regulated Trb3 significantly enhanced osteogenic differentiation of hBMSCs with increased expression of osteogenic markers in vitro. Transplantation of hBMSCs with Trb3 overexpression was further displayed to promote bone repair in mouse calvarial defects. These outcomes suggest that Trb3 is a potentially important therapeutic target to stimulate MSCs for bone regeneration. Further studies will elucidate regulatory mechanisms underlying Trb3-mediated osteogenesis.

13. Meng-Wei Ko (Dr. Jewett)

*Mechanisms of CD8+ T cells Expansion by Super-Charged NK cells*

In expansion of super-charging NK cells, we observed a contamination of CD8+ T cells. In our study, super-charged NK cells showed the ability to lyse CD4+ but not CD8+ T cells. No differences of CD4+ and CD8+ T cells were observed in cell death assay. Super-charged NK expanded CD8+ T cells showed the highest IFN- $\gamma$  secretion among various conditions. In vivo, super-charged NK cells injection increased CD8+ T cells and resulted in increased of IFN- $\gamma$  secretion in oral tumor-bearing hu-BLT mice. Super-charged NK cells select for CD8+ T cells and promote their expansion by increased targeting of CD4+ T cells.

14. Sevda Pouraghaei (Dr. Moshaverinia)

*A bio-inspired adhesive hydrogel for craniofacial bone tissue engineering*

The ultimate goal of craniofacial bone tissue engineering is the regeneration of a construct that matches the physical and biological properties of the natural bone tissue. To address the clinical need for a special biomaterial for craniofacial bone regeneration, here, we have developed a multi-functional, biocompatible, biodegradable, and adhesive cell-laden hydrogel as a light-activated biomaterial for periodontal tissue regeneration. Several parameters have been analyzed to optimize the physical (mechanical, adhesion, degradation) properties. Results demonstrate that the engineered adhesive hydrogels with tunable physical properties have ability to direct human stem cells toward bone-like tissues.

15. Hiroko Okawa (Dr. Nishimura)

*Enhanced osteogenesis of mouse BMSC by Npas2 down-regulation*

A circadian clock molecule neuronal PAS domain 2 (Npas2) played a critical role in titanium implant osseointegration and regulating osteogenesis in bone tissue. The objective of this study was to characterize the role of Npas2 during wound-induced bone regeneration in mice and in vitro osteogenic differentiation of bone marrow stromal cell (BMSC). The peripheral clock gene Npas2 plays a role in regulating the osteogenic differentiation of BMSC in vitro and tooth-extraction induced bone regeneration in vivo. These findings represent an important step toward the therapeutic application of controlling peripheral circadian rhythm to dental implant and periodontitis treatments.

16. Hiroaki Kitajima (Dr. Ogawa)

*Numerical simulation of cellular movement around implant surfaces with different hydrophilicity/hydrophobicity levels using computational fluid dynamics (CFD).*

Ultraviolet treatment of titanium implants makes their surfaces hydrophilic, and enhances osseointegration. However, the mechanism is not fully understood. This study tested the hypothesis that dynamics of stem cells is influenced by the degree of hydrophilicity of implant surfaces and analyzed the blood flow and cellular movement at the implant surface using computational fluid dynamics. The hydrophilic implant surface attracted 10% greater number of cells than the hydrophobic one in 1 second, which would mount to an over 300-time difference in 1 minute. These results suggest that hydrophilicity/hydrophobicity state significantly influence the ability of implant surfaces to recruit cells.

17. Chase Linsley (Dr. Wu)

*Photocurable Bioink for the Inkjet 3D Pharming of Hydrophilic Drugs*

This study reports on the design and characterization of a biocompatible, photocurable polymer for inkjet 3D printing that is suitable for hydrophilic active pharmaceutical ingredients (API). Hyaluronic acid was functionalized with norbornene moieties that undergo a rapid stepgrowth polymerization reaction when exposed to visible light in the presence of poly(ethylene) glycol dithiol and Eosin Y as a photoinitiator through thiol-ene chemistry. The engineered bioink was loaded with Ropinirole HCL, dispensed through a piezoelectric nozzle onto a blank preform tablet, and polymerized. Drug release analysis of the tablet resulted in 60% release within 15 min of tablet dissolution.

18. Giovanni F. Acosta-Velez (Dr. Wu)

*Biocompatible Photocurable Resins for the 3D Pharming of Combination Therapies*

Combination therapies mediate drug synergy to improve treatment efficacy and convenience. However, there are challenges with their manufacturing as well as reduced flexibility in dosing options. This study reports on the design and characterization of a polypill for hypertension, fabricated through the combination of material jetting and binder jetting. The drugs Lisinopril and spironolactone were loaded into hydrophilic hyaluronic acid and hydrophobic poly(ethylene glycol) (PEG) photocurable bioinks, respectively, and loaded onto a blank preform tablet. Drug release analysis showed sustained release profiles for the loaded compounds. This study confirms the potential of 3D Printing for the fabrication of combination therapies.

## **Dental Materials**

19. Samira Rahim Taleghani (Dr. Ogawa)

*In vitro oral bacterial biofilm formation on titanium and zirconium with different surfacetopographies*

Oral community pathogens can colonize an implant surface and develop biofilm compromising the osseointegration and eventually inducing peri-implantitis. The properties of implant materials can affect the attachment of bacteria. In this study, we analyzed the effect of titanium and zirconia disks with various surface topographies on the adhesion and biofilm formation of oral bacteria. The initial adherent bacteria and biofilm formation were evaluated after 24 and 72 hours. The analysis showed that the biomass was generally greater on titanium than on zirconia. There seemed to be less effect of surface topography on zirconia.

20. Faezeh Shahnazi (Dr. Moshaverinia)

*Novel biomimetic nanolayered implant surface with superior osteoconductive properties*

A major clinical issue that limits the success of dental implants is the failure due to suboptimal osseointegration. Here, we have developed a biomimetic coating based on polyphenols to accelerate hydroxyapatite formation on the surface of Ti dental implants. Layer-by-layer deposition of poly(L-lysine) and hyaluronan was used to create nanolayers to serve as a reservoir for rhBMP-2 delivery. Viability, proliferation and osteogenic differentiation of several types of dental derived human stem cells were tested on the engineered surfaces. This approach provides a path to developing the next-generation of biologically integrated dental implants with superior stability, fewer incidences of failure.

21. Jane Lim (Dr. Wu)

*Influence of short-time heat treatment on surface structure and corrosion resistance of a new shape memory abutment system*

A new abutment technology that incorporates a NiTi sleeve has recently been invented to address the complications of existing implant restorations. However, corrosion resistance of the NiTi sleeve has not been studied in detail. In this study, the corrosion resistance of the sleeve was investigated in simulated saliva solution as a function of surface thermal oxidation between 500 to 550°C for 5 to 10 min simulating the shape setting procedure in the manufacture of NiTi devices. Breakdown potentials were estimated from potentiodynamic polarization plots. The surface states and nickel release were investigated by SEM and ICP-OES, respectively.

22. Matthew Rahnama (Dr. Lee)

*Enhanced Osteoinductivity of DBM with Noggin Suppression*

Demineralized bone matrix (DBM) as a potential alternative to autologous bone graft has been increasingly used for bone repair, however, its application in larger defect areas was not successful partly due to lower osteoinductivity. We report a novel strategy that can complement osteogenic activity of DBM by abrogation of BMP antagonism such as noggin using RNAi strategy. Combined treatment of DBM + noggin suppression showed a synergistic effect on osteogenesis of hBMSCs in vitro. The results demonstrate that incorporation of DBM with noggin suppression can enhance osteoinductivity of DBM, potentially broadening application of DBM-mediated bone repair and further animal study.

23. Andre Cataluna (Dr. Wu)

*Size and Stability of Pigments in Solutions Used in Colored 3D Printing*

Currently, most maxillofacial prostheses are manually colored, which involves large amounts of human intervention and high cost. One way to overcome this problem may be through 3D printing of maxillofacial materials with multi-color availability, and the use of an inkjet system. The purpose of this study is, first, to test the effects of surface treatment and ball milling on pigment dispersion size for the inkjet system. And secondly, to test the conditions under which these pigments are most stable within solution. Results showed that a binder system with small enough particle size (<1  $\mu\text{m}$ ) and adequate stability were achieved.

24. Shadi Haykani (Dr. Wu)

*Effects of pH and Temperature on Stress Relaxation of TPU*

Aim of this study was to evaluate the effects of pH (3.0 and 5.0) and temperature (70C and 37C) on the stress relaxation of TPU, a clear aligner material, using the Dynamic Mechanical Analyzer (DMA). Results showed that soaked TPU in acidic buffer (pH 3.0 or 5.0) reduced stress relaxation. After acidic preparation, the remaining stress of TPU is increased, suggesting that more remaining force can be delivered for tooth movement. In summary, acidic medium in our study enhanced the remaining stress of TPU, and can provide potential improvements in manufacturing process to strengthen TPU aligner materials.

25. Ryotaro Ozawa (Dr. Ogawa)

*Creation of a new zirconia surface with CactusNano morphology*

Zirconia has not become an alternative to titanium as an implant material due to limited ability of osseointegration. We have created a new zirconia surface named CactusNano, with distinct surface morphology consisting of meso- and nano-scale structures. This study examined the ability of this surface to promote osteoblastic differentiation. The height of meso-scale structures varied from 20  $\mu\text{m}$  to 80  $\mu\text{m}$ . The expression of bone-related genes was remarkably upregulated on CactusNano surfaces than that on a polished surface and peaked when the height of the meso-structure was 40  $\mu\text{m}$ . The newly created CactusNano zirconia effectively but unproportionally promoted osteoblastic differentiation.

26. Brittany Kane (Dr. Shah)

*CAD/CAM and RP in removable prosthodontics: current applications*

Purpose: Current research on materials, techniques, and applications of CAD/CAM and RP in removable prosthodontics was reviewed. Recent Findings: CAD/CAM and RP technology has shown clinical success in the fabrication of digital denture, RPD frameworks, custom trays and record bases. Methods for prosthesis fabrication are dependent on factors such as CAM software and manufacturer, and often include a combination of conventional and digital techniques. Conclusion: More research is available on CAD/CAM compared to RP, specifically on digital dentures. However, as new materials and technology are developed, the evolution of both CAD/CAM and RP will continue to impact removable prosthodontics.

27. Varisha Parikh (Dr. Shah)

*Bond Strength of Provisional Crown Reline Material to Milled PMMA*

This study focuses on milled PMMA and the bond strength of this material with and without surface treatment to chairside reline materials for provisional crowns. Uniform blocks were milled, their surfaces were treated, and reline materials were applied. The surface treatments utilized were sandblasting, acrylic monomer, and sandblasting with monomer application. The reline materials utilized were jet acrylic, flowable composite, and bisacryl. Load was applied to 6 samples for each of the 12 groups in an Instron universal testing machine. Differences in shear bond strength between each of the experimental groups was observed, and surface treatments significantly increased bond strength.

28. Kristin Hutkin (Dr. Shah)

*PEKK (Polyetherketoneketone): Bonding – A review*

PEKK is appearing to be a popular option for the restoration of a complete arch prosthesis. Clinically, adequate bonding of resin to PEKK framework is a prerequisite for its successful use as a long term fixed and removable prosthetic polymer. Currently, material testing has shown bonding to PEKK is achievable with various bonding agents and surface treatments. As bonding protocol and technology are developed, the evolution of PEKK as a long-term fixed and removable prosthetic material could be comparable material choice to titanium and zirconia. There remains limited data on this and more studies are needed to validate its use.

29. Robert J. Faulkner (Dr. Shah)

*A comparative bond strength analysis of digital denture materials using three common reline materials*

As with all denture therapies, tissues will continually change, leading to the need for a reline. The bond strength of reline materials to digitally fabricated denture materials have yet to be tested. The purpose of this study is to compare the bond strength of reline materials to digital denture materials. Conventional heat-cured, 3d-printed, and milled denture material were used. 3 different common reline materials were also tested. Samples were sandblasted, monomer treated, and the reline material was applied with a jig. Samples were allowed to completely polymerize for 24 hrs. Tensile bond test was performed with an Instron machine.

30. Fangming Li (Dr. Wu)

*Standardized Characterization of Clear Orthodontic Aligners with DMA*

As clear orthodontic aligner treatments gain popularity, there is a corresponding growth in the choices of materials from an increasing number of manufacturers. However, there is a lack of general understanding of fundamental material properties and their indications on clinical efficacies of different materials. We developed reproducible protocols to examine key mechanical properties of clear aligners, including stress relaxation, creep, crack resistance, micro-hardness, water absorption and hydrophilicity on thermoplastic materials after thermo-processing and water absorption with DMA system. The clinical impact is to improve patient care by informing clinicians with evidence based material selection.

31. Mahdi Hasani (Dr. Moshaverinia)

*Development and characterization of a novel bioinspired periodontal membrane*

Periodontitis is a common chronic inflammatory disease that affects tooth-supporting tissues. Here, a series of nanofibrous membranes based on poly( $\epsilon$ -caprolactone) with tunable biochemical and biophysical properties were developed for periodontal tissue regeneration. Bioinspired dopamine coating was utilized to promote the adhesion of therapeutic proteins and cells. Molecular and morphological patterning were utilized to further modify the membranes. Our data showed that the engineered membranes accelerate osteogenic differentiation of dental-derived stem cells. Moreover, through a well-established rat periodontal defect model, we confirmed that our engineered membrane successfully contributed to the regeneration of periodontal tissue and promoted bone repair.

32. Kosuke Hamajima (Dr. Ogawa)

*A newly created CactusNano zirconia surface generates stronger osseointegration than micro-roughened titanium.*

Zirconia has not become an alternative to titanium due to its limited osteoconductivity. We examined the ability of in vivo osseointegration of a newly created zirconia surface with meso- and nano-scale morphology, named CactusNano. The strength of osseointegration measured by the biomechanical push-in test varied with the height of the meso-spike structure and peaked when it was 40  $\mu\text{m}$ . Osseointegration was remarkably greater for the CactusNano surfaces than for the micro-roughened titanium, regardless of the varying height of the meso-spikes. Thus, we have created a new zirconia surface that outperforms osseointegration ability of the most commonly used titanium surface.



33. Mitsunori Uno (Dr. Ogawa)

*A remarkable difference in mechanical interlocking abilities of titanium with different surface morphology and their topographical determinants.*

This study addressed how much mechanical interlocking varies at titanium interface with different surface morphology and identified most contributing factors to it. There was 4-time difference in the interfacial shear stress among the five different surfaces, with a sandblasted and acid-etched surface the highest. Multiple regression analysis identified the developed interfacial area ratio (Sdr) as a most contributing parameter to the shear stress with a 52% coefficient of contribution. There is a remarkable difference in mechanical interlocking ability of titanium with different surface morphology, Sdr is newly proposed as a relevant parameter to determine the interlocking ability of titanium.

34. Yulong Zhang (Dr. Wu)

*The mechanical properties of clear aligners predicted by Time-Temperature Superposition method*

DMA can measure the mechanical properties of samples cut from real clear aligners with tiny size. However, due to its mechanical limitations, DMA only gives data over a limited range of time, and this is inadequate to determine the mechanical changes of the aligners during long-term application in clinic. In the current study, we employed a time-temperature superposition (TTS) technology and were able to probe the viscoelastic properties of the aligners at extreme time scales. The study showed that this technology can successfully analyze several 10min testings, and finally obtain the mechanical properties of thermoplastic aligners at 4 weeks.

35. Yun Chang Lee (Dr. Wu)

*Silicone Powder based 3D printing Technology for Maxillofacial Prostheses*

Rapid Prototyping of silicone for maxillofacial prostheses is highly demanded because conventional process for construction of prostheses is expensive, laborious, and time-consuming. However, current silicone material for 3D printing have limitation in properties. To overcome the limitation of material for maxillofacial prostheses, we report binder jetting based silicone 3D printing approach to build maxillofacial prostheses. With control of silicone powder property based on spray drying and sequential infiltration system, it was possible to highly flexible 3D print structure with complex detail. As a result, silicone powder-based binder jetting material system showed possibility in maxillofacial application.

36. Chung-Sung Lee (Dr. Lee)

*A hybrid 3D scaffold immobilized with hedgehog agonist sterosome*

Here, we fabricated a hybrid 3D scaffold with hedgehog agonist sterosome (HAS) to improve bone repair via bio-inspired dopamine chemistry. PLGA 3D scaffolds were employed to provide space and structure. Thereafter, PLGA 3D scaffolds were immobilized with HAS, which can achieve enhanced delivery of osteoinductive molecules such as 20S-hydroxycholesterol (OHC) and purmorphamine (Pur), acting as smoothed agonist. The HAS-immobilized PLGA 3D scaffold (HAS-S) showed successful cellular attachment and proliferation without cytotoxicity. HAS-S significantly enhanced osteogenic differentiation in vitro through synergistic effect of OHC and Pur. This newly designed hybrid scaffold has simple fabrication method and remarkable bone formation efficacy.