

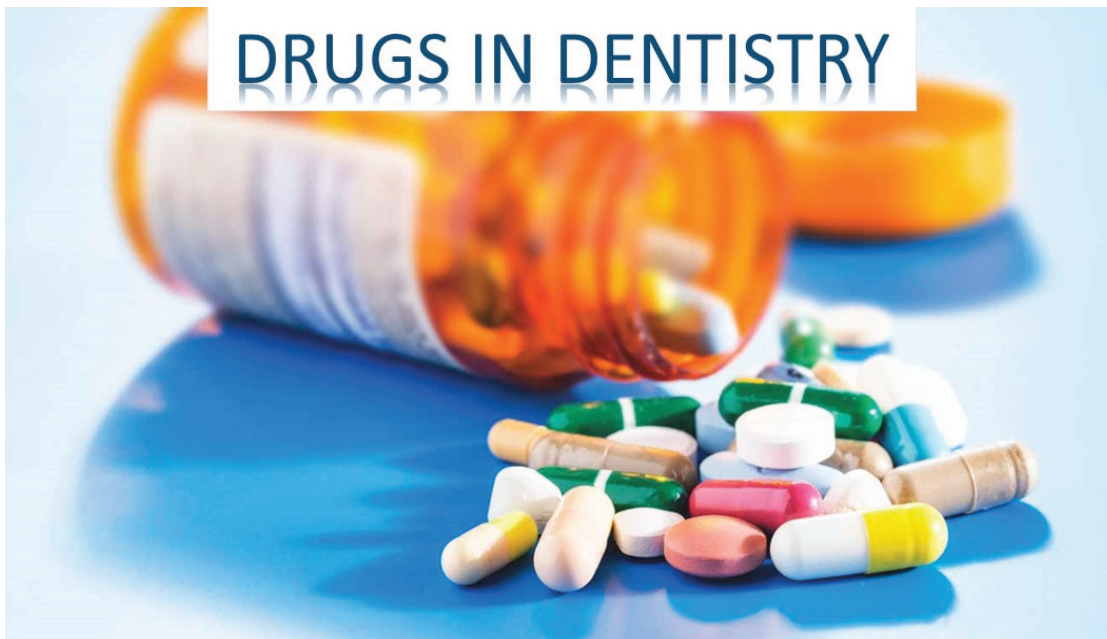
Research Day 2017



UNIVERSITY OF WASHINGTON · SCHOOL OF DENTISTRY



DRUGS IN DENTISTRY



TUESDAY, JANUARY 31, 2017

Organized by the School of Dentistry Office of Research | 206-543-5599 | dentres@uw.edu

Co-sponsors: Philips Oral Healthcare,
Omicron Kappa Upsilon and Seattle Section, American Association for Dental Research

Research Day 2017



UNIVERSITY OF WASHINGTON · SCHOOL OF DENTISTRY

SCHEDULE OVERVIEW

- 8:15 a.m. WELCOME, HUSKY UNION BUILDING 250
JOEL BERG, DDS, MS, *Dean*
MICHELLE STARKE, PhD, *Senior Research Scientist, Philips Oral Healthcare*
- 8:25 a.m. RECOGNITION OF DENTAL STUDENT RESEARCH COMPETITION WINNERS
LINDA LeRESCHÉ, ScD, *Associate Dean for Research and Faculty*

ORAL SESSION

- 8:30 – 9:30 a.m. KEYNOTE ADDRESS
GARY FRANKLIN, MD, MPH
Research Professor, Env. and Occ. Health Sciences & Medicine (Neurology)
Adjunct Research Professor, Health Services
Medical Director, Washington State Department of Labor and Industries
Opioids for Acute and Chronic Pain:
Best Practice Care to Reverse the Opioid Epidemic
- 9:35 – 9:55 a.m. NATASHA FLAKE, DDS, MSD, PhD
Associate Professor of Endodontics
Drug Use and Local Anesthetic Efficacy:
Why Can't I Get my Patient Numb?
- 10:00 – 10:20 a.m. CHRIS HAGUE, PhD
Associate Professor of Pharmacology
"Captivating" Pharmacology
- 10:25 – 10:45 a.m. TRAVIS NELSON, DDS, MSD, MPH
Clinical Associate Professor of Pediatric Dentistry
Temperament and Sedation in Pediatric Dentistry

POSTER SESSION

- 11:00 – 12:30 p.m. POSTER SESSION, HUSKY UNION BUILDING 332

Research and Research Training at the University of Washington School of Dentistry are strong in both scope and diversity, covering fields ranging from microbiology and immunology to population and public health research.

For Fiscal Year 2015 the University of Washington ranked twelfth in the nation in the amount of funding received from the National Institute of Dental and Craniofacial Research (NIDCR), with awards totalling over \$6 million.



In addition to NIDCR support, the School of Dentistry attracts funding from a variety of other government agencies (National Institute on Drug Abuse, Health Resources and Services Administration) and non-governmental sources including strong support from private industry, the Hack Estate, the Dr. Douglass L. Morell Dentistry Research Fund, and from alumni of our various programs. UW's School of Dentistry currently receives support from the following awards:

ACTIVE GRANTS AND CONTRACTS, UW SCHOOL OF DENTISTRY, 2016

NIH TRAINING SUPPORT

- Short-term support for 1 dental student (TL-1)
- Mentored Clinical Science Research Career Development Award
- International Research Training Grant in Epidemiology
- Interdisciplinary Regular Research Training Award
- Interdisciplinary Research Training Award

FEDERAL RESEARCH SUPPORT

- NIH Individual Research Awards (R01)
- NIH Small Research Grants (R03)
- NIH Exploratory Developmental Research Grants (R21)
- NIH Planning Grant (R34)
- NIH Cooperative Agreement (UH2)
- Health Resources and Services Administration

OTHER RESEARCH SUPPORT

- Montana State Department of Health & Human Services
- Public/private colleges, institutions
- Associations, foundations and non-governmental organizations
- Industry sponsored contracts
- Short term support for 7 dental students and 5 faculty projects (Morell)
- Short term support for 3 dental students (Dental Alumni)

KEYNOTE SPEAKER

OPIOIDS FOR ACUTE AND CHRONIC PAIN: BEST PRACTICE CARE TO REVERSE THE OPIOID EPIDEMIC

GARY FRANKLIN, MD, MPH

Research Professor, Env. and Occ. Health Sciences &
Medicine (Neurology)

Adjunct Research Professor, Health Services

Medical Director, Washington State Department of
Labor and Industries

Dr. Franklin has served as the Medical Director of the Washington State Department of Labor and Industries (L&I) from 1988 to the present, and has more than 25-year history of developing and administering workers' compensation health care policy and conducting outcomes research. He is a Research Professor in the Department of Environmental and Occupational Health Sciences and in the Department of Medicine (Neurology), as well as Adjunct Research Professor in the Department of Health Services at the University of Washington (UW). He has served as Director or Co-Director of the NIOSH-funded ERC Occupational Health Services Research training program since its inception.



Dr. Franklin is also Director of the Occupational Epidemiology and Health Outcomes Program at the UW, which is the most productive program of its kind in the U.S. This program houses and facilitates primary research as well as the secondary use of workers' compensation data in order to improve medical care and reduce the disability related to occupational injuries and illnesses. Because of his unique dual directorship roles, he is in a unique position to conduct meaningful policy-relevant health services research, and provide leadership in this area. Dr. Franklin's research has focused on (1) evaluating a major quality improvement program within L&I to reduce worker disability and improve outcomes; (2) identifying predictors of long-term disability among workers with back sprain and carpal tunnel syndrome; (3) assessing the risks associated with opiate use for chronic pain; and (4) evaluating outcomes of lumbar fusion. In addition, since the epidemic of opioid deaths became apparent earlier in the decade, Dr. Franklin has conducted several studies related to opioid prescribing practices, has translated this research directly back into state health care policy, and is leading a statewide effort to educate physicians about best practice use of opioids for chronic non-cancer pain.

UNIVERSITY OF WASHINGTON

FACULTY PRESENTATIONS



DRUG USE AND LOCAL ANESTHETIC EFFICACY: WHY CAN'T I GET MY PATIENT NUMB?

Natasha Flake, DDS, MSD, PhD

Associate Professor of Endodontics

Natasha M. Flake, DDS, PhD, MSD, is an Associate Professor and the Director of Predoctoral Endodontics in the Department of Endodontics at the University of Washington School of Dentistry. She is Director of the Endodontic Clerkship and Chair of the Clerkship Directors Committee at the School of Dentistry. Dr. Flake earned a BS in Biological Sciences from the University of Missouri, a DDS and PhD in neuroscience from the University of Maryland, and an MSD and Certificate in Endodontics from the University of Washington. Her research interests include the mechanisms of nociception, pain, and analgesia, as well as regenerative endodontic outcomes. Dr. Flake currently serves on the Board of Directors of the American Association of Endodontists. Dr. Flake is a

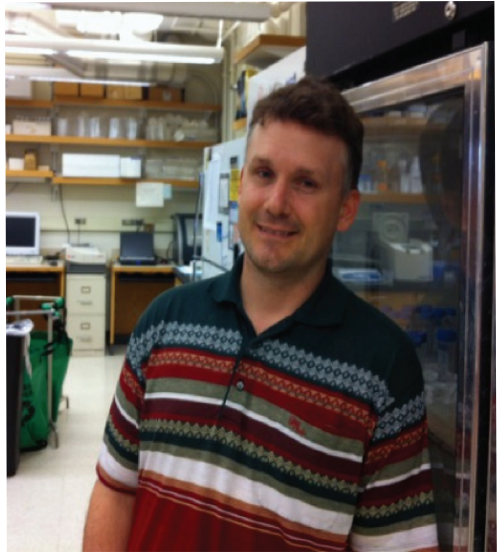
Diplomate of the American Board of Endodontics, and she practices endodontics one day per week in private practice in Seattle, Washington.

“CAPTIVATING” PHARMACOLOGY

Chris Hague, PhD

Associate Professor of Pharmacology

Dr. Christopher Hague is an associate professor in the Department of Pharmacology in the School of Medicine and has been at the University of Washington since 2005. He obtained his Bachelors of Science degree from McMaster University in Hamilton, Ontario, Canada with a dual major in biology and pharmacology. He then obtained his PhD in Pharmacology from Creighton University in Omaha Nebraska where he studied the role of adrenergic receptors in regulating vascular tone of the inferior alveolar artery. He subsequently obtained a post-doctoral fellow position at Emory University in Atlanta Georgia studying the molecular pharmacology of adrenergic receptors. Dr. Hague lectures to medical, dental, pharmacy, graduate and undergraduate students, and has a research laboratory where he studies the molecular architecture of G protein-coupled receptor macromolecular complexes.



TEMPERAMENT AND SEDATION IN PEDIATRIC DENTISTRY

Travis Nelson DDS, MSD, MPH

Clinical Associate Professor of Pediatric Dentistry



Dr. Travis Nelson is a full-time Clinical Associate Professor in the Department of Pediatric Dentistry at the University of Washington, and he maintains privileges at Seattle Children's Hospital. Dr. Nelson received his DDS from Loma Linda University, subsequently completed a residency in Pediatric Dentistry and a Masters of Public Health degree at the University of Washington, and is a Diplomate of the American Board of Pediatric Dentistry. He has authored numerous published articles, and has lectured both nationally and internationally on a variety of topics. His research interests include providing dental care for children with autism, procedural sedation, and educating non-dental medical providers on the importance of pediatric oral health.

FACULTY, GRADUATE STUDENTS, RESIDENT AND INTERNATIONAL SCHOLARS POSTER PRESENTATIONS

1. Andrea B. Burke

The Unique Dental Needs of Patients with Craniofacial Fibrous Dysplasia

Burke AB, Boyce AM, Collins MT

Oral & Maxillofacial Surgery

Purpose: The craniofacial skeleton is the most frequently affected location in Fibrous Dysplasia/McCune-Albright syndrome (FD/MAS). While previous reports have described craniofacial and dental findings in FD/MAS, a definitive description of this cohort is lacking. The aim of this study is to estimate the frequency of craniofacial/dental disease diagnoses in a sample with well-characterized FD/MAS.

Methods: Using a retrospective case series design, we enrolled FD/MAS patients into a natural history protocol between August 1998 and May 2016. Descriptive statistics were tabulated for each study variable: demographics (age, sex), FD type (MAS, polyostotic, monostotic), and clinical and radiographic dental diagnoses.

Results: The cohort is the largest in the world, comprised of 205 subjects, with a mean age of 22 years, 41% male and 59% female. The majority of subjects had MAS (179/205, 87%) with extraskeletal findings. Of this group, 102/205 (46%) received consultation in the NIH Dental Clinic or reported significant dental findings. Dental diagnoses included malocclusion (78/102, 76%), primarily crowding and tooth rotation. Orthodontic therapy was reported in 43/102 (42%) of subjects. Nine subjects (9%) reported root canal therapy. Seventeen subjects (17%) were diagnosed with gingivitis/periodontal disease at the time of evaluation. Thirty-two (32%) subjects had dental caries at the time of evaluation, and nine subjects (9%) had enamel hypomineralization. Five subjects were diagnosed with bisphosphonate-related osteonecrosis of the jaws (5%). Other findings included retained primary teeth (7%), TMJ dysfunction (10%), and short frenum (4%).

Conclusion: FD/MAS subjects with craniofacial disease have unique dental needs that benefit from a multidisciplinary team approach. Findings included an elevated frequency of malocclusion and associated orthodontic treatment. There is also an increased prevalence of ONJ and enamel hypomineralization. These data provide a baseline assessment of fibrous dysplasia's effects on the dentition and craniofacial bones, which will help to predict future treatment needs in this population.

Supported by: Intramural Research Program of the National Institute of Dental and Craniofacial Research (NIDCR, NIH) 1ZIADE000649-22.



2. Hanson Fong

Remineralization Strategies towards Novel Dental Treatments

Fong H^{1,2}, Dogan S³, Yucesoy D^{1,2},
Gresswell C^{1,2}, Saadat S^{1,5}, Sarikaya M^{1,2,4,5}

Genetically Engineered Materials Science & Engineering Center (GEMSEC), Materials Science & Engineering, Restorative Dentistry, Chemical Engineering, Oral Health Sciences

Objectives: Dental caries is a global health issue that affects a large percentage of the population despite the wide use of fluoride and other preventative treatments. Early stage caries can reveal itself in various clinical conditions, e.g. white spot lesions (WSL), incipient caries, or tooth hypersensitivity. If not treated early, it can lead to complex restorative procedures or tooth lost. The objective of this study is to develop a peptide based biomimetic remineralization treatment product that can reserve tooth decay.

Methods: An amelogenin-derived peptide (ADP) with Ca/PO4 mineralization catalyzing action has been developed through combinatorial/bioinformatics selection and binding/mineralization assays. The efficacy of ADP in remineralizing of artificially created carious tooth lesions were tested either in vitro on extracted human teeth or in vivo with Sprague Dawley rats. Samples were incubated either in aqueous solutions of ADP followed by aqueous Ca/PO4 for 70 mins total at 37C or as a gel formulation incorporating ADP and Ca/PO4 also for 70 minutes at 37C for the in vitro tests. Gel formulation was applied for 7 once daily for 2 weeks for the in vivo experiments. No treatment or Ca/PO4 only treatment served as control groups. SEM and indentation tests were used to evaluate the new mineral layer microscopically and mechanically.

Results: In both aqueous solution and gel in vitro studies, ADP treated groups revealed continuous mineral layers with approximately 5 um/hr remineralization rate compared to no detectable continuous mineral layer in the control groups. Resulting layers had hardness comparable to dentin. In vivo studies revealed 5-10 um thick mineral layers resulted in peptide treatments vs. no detectable mineral layer in the control group.

Conclusion: The results of these studies suggested that the ADP based gel can be viable in reversing caries through remineralization.

Future Prospects: Based on the in vitro and invivo (rat) remineralization research so far, the team, through an interdisciplinary collaborations, is developing a variety unique formulations, developing dental products including mineralizing lozenges and chewing gums and not only treating incipient caries and WSL, but also working on antihypersensitivity gels, biomimetic composites for pulp caps and fillers, bone powder, and whitening products as well as antimicrobial and anticlonal pastes and gels.

Supported by: NSF-MRSEC, Life Science Discovery Fund, Dean and Margaret Spencer Endowed Clinical Research Fund

¹ Genetically Engineered Materials Science & Engineering Center (GEMSEC), UW

² Materials Science & Engineering, UW

³ Restorative Dentistry, UW

⁴ Chemical Engineering, UW

⁵ Oral Health Sciences, UW

3. Sanaz Saadat

Sub-chronic Oral Toxicity of Remineralizing Peptide Determined via Histopathology

Saadat S, Fong H, Yucesoy D, Gresswell C, Sarikaya M
Oral Health Sciences, Genetically Engineered Materials Science & Engineering Center (GEMSEC)

ADP5- is an amelogenin-derived peptide which facilitates cell-free remineralization of dental tissues. It has been shown in vitro and in vivo that ADP5 can drive mineral layer formation on carious lesions. For future, therapeutic application in humans needs to be demonstrated. The objective of this study is to assess the toxicity and histopathological effects, if any, of this peptide.

Sprague Dawley rats went through fifteen consecutive days of peptide remineralization treatment after moderate caries were developed. Gels containing ADP5 and Ca/PO4 and common toothpaste inactive ingredients developed in the Sarikaya Lab were delivered topically once daily onto the rats' molars while under sedation. They were kept sedated for 1 hour before returning to their cages. The control group received no treatment. During the treatment period, all subjects were monitored for symptoms of toxic or allergic reaction,

visible discomfort, excess salivation, liquid feces, tremors, change in food consumption or convulsions, and paralysis. When peptide treatment period was concluded, animals were sacrificed and tissues were collected. The tissues then went through immunohistochemistry for the histopathological investigation to inspect the toxicity of the peptide on relevant tissues.

Histopathological investigation revealed no structural/histopathological alterations compared to rats receiving no treatment on control group. Degenerative deviations and vascular changes, apoptosis, necrosis was not detected in the investigated tissues including liver, kidney, heart, stomach, intestine, bladder, tongue, lung, spleen. The histological results so far have shown no damaging effect to livers, kidneys of ADP5 treated animals. Similarly, other tissues like heart, stomach, intestine, bladder, tongue, lung, spleen have shown no histological differences compared to the untreated control group.

While this study is still ongoing, the overall results of this study has demonstrated that oral administration of ADP5 at low or at acute doses did not induce any behavioral, physical, phenotypical or histopathological alterations.



4. Samuel Finkleman Treatment of White Spot Lesions with a Novel, Remineralization Peptide

Finkleman SA, Fong H, Huang GJ, Sarikaya M, Greenlee GM

Orthodontics, Materials Science and Engineering

Objectives: White spot lesions (WSLs) are unsightly demineralized areas that form on the enamel surface, often as a result of poor oral hygiene during orthodontic treatment. A significant percentage of orthodontic patients develop WSLs, even though most orthodontists employ preventive education and therapy. Several products are commercially available to treat WSLs, including MI-Paste-Plus. A novel remineralization peptide has been developed at the UW to treat WSLs. In this study, we sought to compare the efficacy of MI-Paste-Plus and the novel peptide in reversing artificial WSLs by evaluating macroscopic and microscopic changes.

Methods: Artificial WSLs (N=33) with depths of approximately 300 micrometers were produced on extracted human teeth by demineralization in a Ca/P containing acetic acid solution (pH 4.5). Teeth were divided into three experimental groups (n=11 per group): artificial saliva, MI-Paste-Plus, and novel peptide. Each group received 4 weeks of treatment in their respective agents. Digital photographs were captured before and after the demineralization/remineralization processes. After the remineralization process, scanning electron microscopy and micro-computed tomography were performed to assess the effect of the remineralization agents, compared to the control.

Results: While treatment of artificial WSLs with MI-Paste-Plus and novel peptide did not result in clear visual improvements, both interventions generated a layer (approximately, 10 micrometers) of mineral at the surface of the WSLs. The layer of mineral formed in the MI-Paste-Plus samples was rich in silicon, which is a main component of the filler. However, the mineral layer formed through peptide treatment was predominately Ca/P, the primary chemistry of mineralized enamel.

Conclusion: Visual improvements in WSLs were not produced with either MI-Paste-Plus or novel peptide. Both agents produced layers, but only the peptide-directed layer yielded mineral resembling enamel. Future work will involve exploring methods to infiltrate WSLs with peptide-directed mineralization, as a means to “heal” lesions and achieve visual improvement.

Sponsored by: University of Washington Dr. Douglass L. Morell Dentistry Research Fund

5. Yu Lwo

Characterization of MAIT Cells in Inflamed and Healthy Oral Mucosa

Slichter C, Woodward Davis A, Ko A, Lwo Y, McLean J, Dutta M, Berkson J, Yajima M, Deng J, Gottardo R, Prlic M, Dixon D

Periodontics, Fred Hutchinson Cancer Research Center

Mucosal associated invariant T (MAIT) cells are recently discovered lymphocyte populations which comprise 1-8% of the lymphocyte population in the peripheral blood and digestive tract. MAIT cells are either CD8+ or CD4-CD8- (DN) and are characterized by expression of an invariant T cell receptor (TCR), (V α 7.2), and high expression of the cell surface marker CD161. Previous work shows that upon stimulation, MAIT cells secrete pro-inflammatory cytokines. The purpose of this study was to quantify and characterize the phenotype of MAIT cells in human oral mucosa compared to MAIT cells in peripheral blood. We hypothesized that MAIT cells are activated in diseased oral mucosa compared to healthy oral mucosa and contributes to inflammatory regulation of bone metabolism. To test this hypothesis, we used flow cytometry to isolate and quantify CD8+ MAIT cells from discarded oral mucosal tissues and peripheral blood from three donors with periodontal disease and three donors in health. RNA sequencing was then performed on the cell populations to compare 174 genes with potential effect on bone metabolism.

The frequency of MAIT cells in the oral mucosa is similar to that of other mucosal tissues, which counted higher proportion in mucosal tissue compared to peripheral blood. RNA sequencing analysis of 174 genes revealed 83 significantly expressed genes, with 25 of those unique to diseased tissues while 4 were unique to healthy tissues.

Of the genes significant to healthy tissues, three were seemingly more related to bone anabolism. With diseased tissues, the significant genes were mostly related to bone catabolism. These pro-inflammatory cytokines may have an effect on increasing the expression of RANKL, which promotes osteoclast activity and bone resorption. The difference in expression between diseased and healthy tissues show that MAIT cells in inflammatory conditions may contribute to bone catabolism. Further studies are necessary to confirm these results.

Supported in part by NIH grant DP2DE023321 (to M.P.)

6. Withdrawn



7. Nutthapong Kantrong Bacterial Internalization and Non-Canonical Toll-like Receptor 4(TLR4) are Required for Chemokine Ligand-8 (CXCL-8) Response by Oral Epithelial Cells

Kantrong N, Coats SR, Darveau RP

Oral Health Sciences, Periodontics

Objectives: CXCL-8 production by oral epithelial cells (OECs) is essential for neutrophil homing to the junctional epithelium. However, it is unclear as to whether bacterial internalization is required and whether Toll-like receptor (TLR) 2 and 4 are involved in this induction. Therefore, we sought to characterize TLRs that participate in CXCL-8 induction in response to *Fusobacterium nucleatum* as well as to investigate the role of bacterial internalization in CXCL-8 response by OECs.

Methods: Human OECs were challenged with live *F. nucleatum*, its cell walls, or different isolated bacterial ligands and the culture supernatants were assayed for CXCL-8 protein. To examine if TLR2 and TLR4 are involved in OEC recognition of *F. nucleatum*, transient TLR2 and TLR4 expression in HEK293 cells were performed to determine if the test bacterium was capable of eliciting TLR2 and TLR4 activation. The requirement of OEC actin integrity for CXCL-8 induction was investigated by pretreating OECs

with Wiskostatin, an actin polymerization blocker, prior to bacterial stimulation. In addition, LPS delivery into OECs was performed in order to determine if intracellular TLR4 is present in OECs and involved in this induction.

Results: Here, we demonstrated that *F. nucleatum* interacts with both human TLR2 and TLR4 and that live *F. nucleatum* and its cell walls, with an exception of bacterial LPS, induced CXCL-8. *F. nucleatum*-induced CXCL-8 expression was suppressed when OECs were pretreated with Wiskostatin. Although GEC did not respond to purified TLR4 agonists, intracellular introduction of *E. coli* or *F. nucleatum* LPS into OECs up-regulated CXCL-8 level, thus indicating that bacterial endocytosis and non-canonical TLR4 are essential for this response.

Conclusion: This study provides novel evidence that, in OECs, CXCL-8 induction requires multiple TLR engagement, particularly TLR2 and TLR4, thereby mounting an effective host defense in response to microbial infection. These data also identify the functional participation of non-canonical TLR4, at which internalized bacterial LPS targets for CXCL-8 induction in OECs.

Supported by: NIH R01DE023453



8. Shatha Bamashmous Gingival Health Diagnostic Model for Neutrophil Migration

Bamashmous S, Kim AS, McLean JS, Kotsakis GA,
Darveau RP

Oral Health Sciences and Periodontics

Objectives: Neutrophil homing to clinically healthy tissue, similar to the inflammatory response, is a highly selective process where the expression of different neutrophil chemokines is tightly regulated to ensure host protection from plaque bio-film growth and yet not causing tissue damage. Our lab has published the first evidence that the selective use of neutrophil chemokines in response to commensal bacteria contribute to periodontal tissue homeostasis. However, little is known concerning how humans regulate neutrophil transit for optimal gingival health. This study provides a gingival health diagnostic model for neutrophil migration.

Methods: This pilot study explores types and amounts of major neutrophil chemokines in healthy human gingival tissue. Gingival crevicular fluid (GCF) was collected from healthy adolescents aged 12 -17 years at the Center for Pediatric Dentistry for chemokines analysis using Multiplex Immunoassay. Also, subgingival plaque sampling was performed to characterize subgingival bacterial community via high-throughput sequencing of 16S rRNA gene using Illumina MiSeq platform.

Results: The preliminary data showed significant variability in the neutrophil chemokines expression and number of neutrophils as measured by myeloperoxidase (MPO) among the healthy subjects. In addition, strong correlations between the number of neutrophils and the amount of neutrophil chemokines were also observed rendering confidence that we are detecting relevant chemokine markers. 16S rRNA gene microbial analysis revealed species diversity among healthy individuals. Additionally, these data were used to investigate if variations in neutrophil chemokines expression observed among individuals could be correlated to the microbial composition.

Conclusions: This represents first most complete analysis of neutrophil chemokines found in the clinically healthy condition. Ultimately, understanding the profile of specific chemokines in the gingival crevicular fluid under healthy condition will allow the assessment of GCF as a potential diagnostic marker.

Supported by: Elam M. and Georgina E. Hack Memorial
Research Fund

9. Andrew I. Brodsky Evaluation of Post-Translational Collagen Synthesis in PDL Tissue Exposed to the Oral Environment

Brodsky A, Hudson D, Weis MA, Dixon D, Eyre D,
Popowics T

Periodontics, Orthopaedics and Oral Health Sciences

Previous research efforts regarding human collagen formation have revealed three important findings: specific post-translational modifications of collagen within periodontal ligament (PDL) are essential for proper fibril organization and formation; certain modifications are unique and conserved for human PDL type I collagen; and genetic disruption of any of the key factors can lead to significant disruption of collagen formation and disease states. However, what is not currently understood is if natural exposure of PDL collagen to the oral microbial environment could also disrupt/alter post-translational type I collagen modifications, thereby adding to or initiating disease. Therefore, the aim of this study is to determine if the microbial environment/host response disrupts key post-translational collagen modification(s) by directly comparing healthy, non-exposed, human PDL type I collagen samples to samples obtained that were naturally exposed to the oral microbial environment. Analyses may include Type I collagen preparation (SDS-extraction, trypsin digestion), mass-spectrometry elucidation of alterations on specific post-translational modifications (PTMs) including hydroxylase, glycosylation, lysyl oxidase (LOX) mediated cross-linking as well as procollagen peptidase disruption or microbial/host protease activity.

Specimens were obtained from extracted human teeth and surgically processed to collect PDL samples from apical (control; non-exposed) and coronal (test; oral-exposed) sections of these extracted teeth (n=15). Each tooth sample served as its own control by providing both test and control samples. Disruption of PTMs, collagen alpha chain (tropocollagen) length or structural features as well as immature and mature cross-links will be quantified and compared using the Student's t-test. Transmission electron microscopy (TEM) procedures will be used to image PDL collagen fibrils in transverse and cross-section. Physical features of collagen fibrils will be measured and compared between non-exposed and exposed collagen samples. The completion of this study will provide essential data on the post-translational modifications that define PDL collagen in relation to oral microbial exposure.

Supported by: Elam M. and Georgina E. Hack Memorial Research Fund

10. Mikhail Garibov

Collagen Post-Translational Features are Conserved in Periodontal Ligament

Garibov M, Hudson D, Dixon D, Popowics T, Eyre D
Periodontics, Orthopaedics, and Oral Health Sciences

Introduction: Collagen synthesis is a complex process with numerous post-translational modifications including hydroxylation, glycosylation, and cross-linking. Little is known regarding collagen formation in periodontal tissue as previous research has focused primarily on collagen fibrillogenesis in skin, bone, and tendon.

Objective: The purpose of this study was to identify evolutionarily conserved post-translational variances between murine and human type I collagen α -chains from PDL and tendon as well as compare mean type I collagen fibril diameter between the species via transmission electron microscopy (TEM).

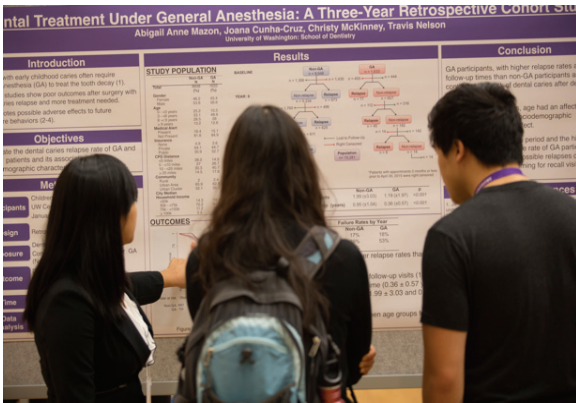
Experimental Methods: PDL tissue was harvested from extracted healthy human teeth. PDL tissue dissected from extracted murine molars was pooled for collagen analysis (2 groups, 8 mice each). Tandem mass spectrometry was used to evaluate several known sites of prolyl-3-hydroxylation, lysine hydroxylation, and subsequent glycosylation in type I collagen. For TEM, whole mandible was harvested from a C57Bl/6 mouse sacrificed at 41 days postnatal. Extracted human tooth with alveolar bone attached was obtained during a routine procedure in graduate periodontics clinic. Both samples were decalcified and then prepared for TEM analysis.

Results: Our results indicate that type I collagen from PDL has a unique post-translational phenotype. For example, at the $\alpha 1(I)$ sites, Pro707 and (GPP)n, which are highly modified in mouse and human tendon, are completely lacking in PDL tissue from both species. At the same time, mouse and human PDL type I collagen show cross-species similarities as evidenced by glycosylation patterns at $\alpha 1(I)$ K87. Collagen fibril diameters from human and mouse PDL were almost identical with values of 57.0 ± 6.2 (n=2830) nm in human and 56.6 ± 6.4 nm (n=2589) in mouse.

Conclusion: PDL type I collagen shows a unique PTM phenotype, and these observations confirm that the mouse is an appropriate model to study human PDL due to evolutionarily conserved features and similar fibril diameters.

Funded by: National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Numbers AR037318 and AR036794, Elam M. and Georgina E. Hack Memorial Research Fund





7 times greater than in the controls ($p < 0.01$). Collagen and empty profiles resembling fat or degenerated muscle fibers appeared less prominent away from the injection site.

Conclusion: BTX had a diminished, yet still significant effect far from the injection site, with more unaffected fibers available to hypertrophy in order to compensate for the affected fibers. We speculate that the toxin diffuses within the muscle. Muscular damage from BTX injection is not a local phenomenon but is widespread in the masseter.

Supported by: NIH R01DE018142 and T90DE021984

11. Michael Baldwin Botox-Injected Muscle Damage Is Not Confined to the Injection Site

Baldwin M, Rafferty K, Herring S

Oral Health Sciences, Orthodontics

Objective: Paralysis of the masseter muscles using botulinum toxin (BTX) is a common treatment for cosmetic reduction of the masseters, muscle spasm, and pain. We previously reported muscle degeneration and collagen accumulation near the injection site in rabbit masseters (IADR 2013 #1016); however, it was not clear whether these changes were due to localized damage or whether they affected distant parts of the masseter. The purpose of the present study was to examine a site in the muscle distant from the injection site to determine if it also showed degenerative changes.

Methods: Rabbit masseters were injected unilaterally in the lower third of the muscle with BTX ($n=8$) or saline ($n=4$) and euthanized after 12 weeks of recovery. Muscles were cross-sectioned and stained with trichrome. Sections from the inferior third (injection) and superior third (distant) were compared for fiber size, fat and collagen content, and number of fibers with central nuclei.

Results: The distant location showed similar atrophy to the injection level (minimum fiber diameter $8\mu\text{m} \pm 3$ vs. $16\mu\text{m} \pm 4$ in controls, $p < 0.001$), however, hypertrophied fibers were 2 times more frequent ($p < 0.03$) and increased in diameter (maximum fiber diameter $89\mu\text{m} \pm 18$ vs. $66\mu\text{m} \pm 10$ in injection site, $p < 0.02$ and $58\mu\text{m} \pm 6$ in controls, $p < 0.001$). Also similar to the level of injection, the number of fibers with central nuclei was



12. Mohamed Yehia Saad Abdelfattah

Evaluation of Botox Effect on Submandibular Salivary Gland of Rats

Abdelfattah MY^{1,2}, Sherif H³, Dameer H³, Abouzid W⁴, Liu ZJ¹

Orthodontics (UW, USA), Oral Biology (Assiut University, Egypt), Oral Biology (Al-Azhar University, Egypt), Basic Dental Science National Research Centre (Egypt)

Objectives: Botulinum toxin A (BoNT) has been used for treating hyperfunction of various glands such as sweat, lacrimal, and salivary glands. However, the long-term histological sequences are largely unknown. The present study is to evaluate the histological and ultrastructural effects of BoNT on submandibular salivary glands (SSGs).

Methods: Eighteen 6-week-old male albino rats received 0.1 ml of either saline or BoNT injection in the right SSG, and 9 rats in each group were terminated at 2, 4 and 12 weeks after the injection (n=3 in each time point). The harvested SSGs were embedded, sectioned at 6µm, and stained with H&E for histological study. Small pieces (1mm³) were obtained from the center of SSG, and sectioned at 60-90nm. These sections were mounted on copper grids for ultrastructural study using transmission electron microscope (TEM).

Results: Sham groups showed normal acinar cells with rounded nuclei, and striated ducts (SD) with columnar cells, central nuclei, and basal striations. By TEM, acinar cells exhibited rounded nuclei, mitochondria, and secretory granules in cytoplasm. Numerous mitochondria presented in SD. No noticeable changes were identified over time in sham SSGs. Compared with these features, 2-week BoNT-injected SSG showed losses of spherical fashion and basal striations in serous acini and SD, respectively, and the cell boundaries were not clear. TEM further revealed the irregular nuclei in acinar cells and SDs with swollen mitochondria. In 4-week SSGs, acinar cells and SDs lost their spherical fashion. In some area, these structures disappeared. Ruptured mitochondria were observed. However, 12-week BoNT-injected SSGs seemed to have similar structures to those of sham SSGs.

Conclusions: Although application of BoNT results in significant damages in SSGs, these detrimental effects seem to be transient and major recovery occurs in 3 months. Thus, BoNT can be used for treating SSG hyperfunction.

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13. Mengzhao Deng

Functional Tongue Motion in East African Open Bite Patients

Deng MZ^{1,2}, Leotta D³, Huang GJ¹, Liu ZJ¹

Orthodontics (UW), Orthodontics (Sichuan University, China), Center for Industrial and Medical Ultrasound (UW)

Objective: The role of the tongue in the pathophysiology of anterior open bite (AOB) is poorly understood. This study characterized functional tongue motion in East African children with and without AOB.

Methods: Of ten 9-12 old children of East African descent recruited, five with negative or < 1.0 mm overbite were categorized to AOB or AOB tendency group; the other 5 with overbite larger than 1.0 mm were taken as control. Ultrasound imaging of the tongue was performed with the subject seated in a dental chair for two conditions: chewing, and command-initiated water-swallowing, in sagittal and coronal projections. The orientation and probe location were recorded by a spatial tracking system in the submandibular region. Both the sagittal and coronal views were traced and analyzed to acquire two-dimensional tongue surface contours for chewing and swallowing. Custom MATLAB software was used to create correlation maps of tongue movement from these tracing contours.

Results The average of tongue motion was greater for swallowing than chewing in the control, and larger difference was found in AOB. Compared to that of control, the average of tongue motion for both swallowing and chewing was greater in AOB. In sagittal view, the movements of the anterior and the posterior portion of the tongue surface were in the opposite direction in control during chewing and swallowing, while the tongue movement pattern of AOB seemed more irregular than that of control. In coronal view, the movement of the middle part of the tongue was inconsistent with the movement of the left and right side during swallowing and

chewing, and this difference was more obvious in AOB.

Conclusions: These results suggest that 1) the tongue may need to move more during chewing and swallowing to meet the functional demands in AOB; 2) the tongue movement pattern of AOB seems more irregular than that of control.

Supported by: Royalty Research Fund, University of Washington.

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14. Fedora Katz

Reducing CBCT Radiation Dose without Losing Orthodontic Diagnostic Information

Katz F, Aps J, Bollen A-M, Herring S, Spiekerman C
Orthodontics and Oral Medicine

Orthodontics is increasingly employing CBCT for diagnosis. Appropriate measures to reduce radiation dose without loss of diagnostic information are essential in this typical young orthodontic patient population.

Aim: To verify CBCT radiation dose in the head and neck area under varied exposure settings, and to assess the influence of these settings on the identification reliability of typical cephalometric reference points.

Material and methods: A human cadaver placed in a Morita Accuitomo 170® CBCT machine was imaged under various combinations of exposure settings (60, 70, 80, 90 kV- 1, 2.5, 5 mA - 180°, 360° rotation arc). For each settings combination, 3 TLDs were glued on the skin surface overlying the selected organs. Reconstructed cephalometric images were assessed by 10 orthodontists. Measurements were compared with respect to mean error matched by rater and scan settings (permutation tests).

Results: For the lens of the eye an 8-fold dose reduction was observed when the rotation arc reduced from 360° to 180° ($P=0.0004$). Also a 2.3-fold reduction when mA was reduced from 5 to 1 ($P=0.0424$). The dose to the parotid was halved when mA decreased from 5 to 2.5 ($P=0.0322$), 2.5-fold reduced when decreased from 2.5 to 1 ($P=0.0081$) and 6-fold reduced when mA reduced from 5 to 1 ($P=0.0008$).

With regard to cephalometric reference points, no statistically significant differences were observed between images taken at 360° or 180° rotation, while decreasing the mA resulted in statistical significant increases in variance. Cephalometric reference points and measurements on images taken at 60 or 70 kV, showed increased statistically significant variance compared to images taken at higher kV.

Conclusion: For cephalometric analysis, it is recommended to retain the manufacturer's mA and kV exposure settings, but to reduce the rotation arc from 360° to 180, resulting in a 50% dose reduction.

Supported by: UW Orthodontic Alumni Association

15. Austin Gaal

Limited Antibiotic Dosing During the Operative Management of Mandible Fractures Is NOT Associated With an Increased Risk for Surgical Site Infections

Gaal A, Bailey BA, Patel Y, Smiley N, Dodson TB, Kim DS, Dillon JK

Oral and Maxillofacial Surgery

Purpose: To estimate and compare 1) the frequencies of surgical site infections (SSIs) and 2) adverse antibiotic effects (AAEs) between patients who receive only intraoperative antibiotics (study group) and those who receive intraoperative antibiotics plus additional preoperative or postoperative antibiotics (control group) while undergoing operative treatment of open mandibular fractures.

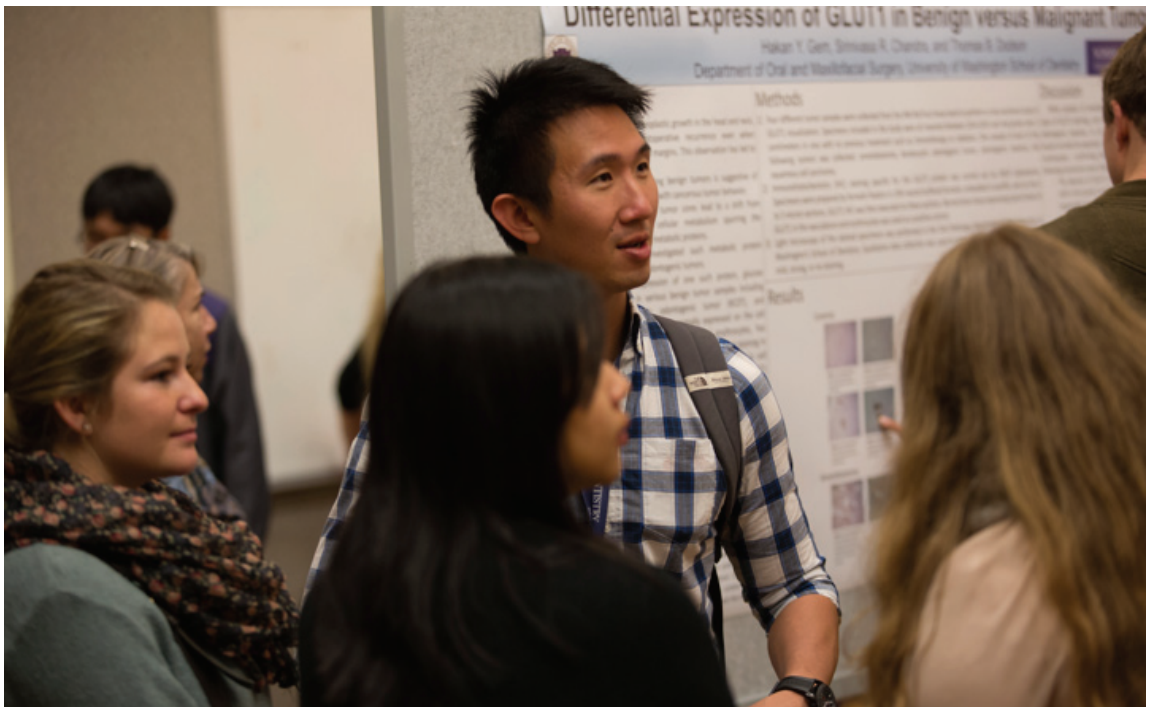
Materials and Methods: The authors designed a retrospective cohort study and enrolled a sample derived from patients presenting to the Harborview Medical Center from 2009 through 2014 for the management of open mandibular fractures. Eligible patients were at least 18 years of age with open, isolated mandibular fractures treated by open reduction and internal fixation using transoral approaches or closed reduction and intermaxillary fixation. The primary predictor variable was antibiotic exposure. Study group received antibiotics administered within 1 hour before the incision, with possible intraoperative re-dosing, and the control group received antibiotics according to the study group plus preoperative or postoperative antibiotics. The primary outcome was SSI frequency. The secondary outcome was AAE

frequency. Univariate, bivariate, and multiple logistic regression analyses were performed. Statistical significance was set at a P value less than or equal to .05.

Results: The sample was comprised of 510 patients (mean age, 29yr; 86% men). The study group had 58 patients (11%) and the control group had 452 patients (89%). The SSI frequencies in the study and control groups were 9 and 17%, respectively ($P = .13$). There were 5 (1%) AAEs reported, all in the control group. In the multivariable logistic regression model, only tobacco use was associated with an increased risk for SSI (odds ratio = 2.8; 95% confidence interval, 1.5-5.5; $P = .0015$).

Conclusion: Limiting antibiotic exposure to only intraoperative antibiotic prophylaxis in patients undergoing transoral operative treatment of isolated open mandibular fractures was not associated with an increased risk of SSIs.

Partial support provided by the UW Department of Oral and Maxillofacial Surgery Resident and Education Fund



SURF AND 4TH YEAR DENTAL STUDENT RESEARCH PROGRAMS POSTER PRESENTATIONS

16. Bryce Jeffrey Planchich Differential Secretion of Mineralized Matrix Forming Proteins by Dental Pulp Cells Exposed to Calcium Titanates

Planchich BJ, Drury JL, Chen YW, Taylor-Pashow
KML, Hobbs DT, and Wataha JC

Restorative Dentistry

The multipotent capabilities of Dental Pulp Cells (DPCs) place them at the forefront of regenerative dental procedures, while the creation of a device with the ability to modulate DPC remineralization is under heavy investigation. The benefits of applying Calcium(II) ions (Ca(II)) to the oral cavity is well documented. Monosodium titanates (MST) complexed with Ca(II) (MST-Ca(II)) exhibit the ability to store and deliver Ca(II) to the oral cavity. The objective of this study was to investigate MST-Ca(II) effect on the secretion of integral matrix-forming proteins (DMP1, ALP, Osteocalcin) by DPCs. In this study, DPCs, isolated from extracted third molars, were cultured using standard growth media or DPC differentiation media and exposed to native MST or MST-Ca(II). At times 0, 7, 14, and 21 days, media supernatants were removed and analyzed for protein content using RayBiotech ELISA Kits. Results across all conditions, including controls, for all proteins were inconsistent. Although, precise standard curves were achieved indicating the ELISA kits were functioning properly. Positive results from the osteocalcin controls and experimental conditions, 1.28-1.42 ng/mL for Growth Media and 0.242-0.390 ng/mL for Calcification Media at Day 21, suggest that the DPCs remained viable throughout the experiment. Inconsistencies in the results imply an issue with the differentiation of the DPCs and subsequent protein secretion by these cells, leaving any further interpretation of the results at risk. Although the results do not substantially complete the objective, this study will explore the potential mechanisms of action of MST-Ca(II) on DPCs and the potential errors that took place.

Supported by: Dean and Margaret Spencer Endowed
Clinical Research Fund, University of Washington
Dr. Douglass L. Morell Dentistry Research Fund

17. Paul Joseph Lutgen Effects of Silver Diamine Fluoride on Dentin Bond Strength

Lutgen PJ, Chan DC, Sadr A

Restorative Dentistry

Objective: To evaluate the bonding efficacy of adhesive systems to dentin treated with silver diamine fluoride (SDF) using different protocols.

Methods: Micro-shear bond strength (MSBS) to sound human dentin was investigated using three adhesive systems: Clearfil SE bond 2 (CSE), Scotchbond Universal in both self-etch (SBU) and phosphoric-acid (PA) etching (SBT) modes, each in 4 experimental subgroups (n=10) depending on SDF pre-treatment of dentin before bonding.

Control: Treated with deionized water (no SDF pretreatment). P1: SDF applied for 10-s, no rinse. P2: SDF applied for 10-s, rinsed off after 1-min. PR: superficial dentin polished off after 24-h following P1. Samples were stored in deionized water at 37°C for 24 h prior to MSBS testing. Data were analyzed using two-way ANOVA and post hoc tests ($\alpha=0.05$).

Results: Adhesive, SDF and their interaction were significant factors ($p<0.05$). Overall P1 showed the greatest reduction in MSBS for all adhesives. P2 improved bonding compared to P1 but less so than PR across all groups. SBT and CSE groups performed similarly using P2 ($p>0.05$). SBT and CSE groups using PR were not statistically different from controls ($p>0.05$).

Conclusion: The application of SDF may significantly decrease the bond strength of composite to dentin depending on the protocol and adhesive system used. Rinsing with water spray for 15-s improved bond strength but superficial refreshing of SDF treated dentin prior to bonding showed the highest bond strength. The two-step self-etch adhesive and the universal adhesive in PA-etching mode showed better performance than universal adhesive alone on SDF treated dentin.

Supported by: University of Washington Dental Alumni
Association

18. Sesha Hanson-Drury

Draft Genome Sequence of *Tannerella forsythia* Clinical Isolate 9610

Hanson-Drury S, To T, Liu Q, Vo AT, Kim M, Watling M, Roger S, Bumgarner RS, McLean J

Periodontics

Objective: *Tannerella forsythia*, a Gram-negative oral anaerobe, is one of three members of the “red-complex” of periopathogens associated with development of periodontitis. Due to *T. forsythia*’s fastidious growth requirements, relatively little is known of its inter-microbial relationships and virulence mechanisms. The aim of this study is to culture, sequence and perform comparative genomics for *T. forsythia* clinical isolate strain 9610.

Methods: Isolate 9610 was serially diluted on blood agar medium for a total of 3 passages, anaerobically incubated at 37 degrees Celsius for 3 days, then anaerobically incubated in SHI liquid media at 37 degrees Celsius for 3 days prior to generation of final 20% glycerol stock solution. Genomic DNA extraction was performed utilizing QIAgen DNeasy blood and tissue kit, then purified using Zymo Research DNA Clean & Concentrator kit. The Illumina MiSeq platform was used to produce paired-end 300 bp reads, which were then assembled using SPAdes 3.9.0.

Results: The genome is composed of 79 scaffolds with 82 contigs for a length of 3,201,941 bp and a G+C of 47.3%. Annotation performed by National Center for Biotechnology Information (NCBI) Prokaryotic Genome Annotation Pipeline (PGAP) found a total of 2,620 genes, composed of 2,569 coding genes, 44 tRNAs, 5 rRNAs, and 1 clustered regularly interspaced short palindromic repeat (CRISPR). Phylogenetic placement of isolate 9610 was inferred by creating a 16S rRNA gene phylogenetic tree. The closest sequenced relatives were found to be *T. forsythia* strain KS16, 92A2, and ATCC 43037, with an average amino acid identity (AAI) of 98.26%, 97.93% and 97.77%, respectively. When isolate 9610 was compared to KS16, 92A2, and ATCC 43037 via Rapid Annotation using Subsystem Technology (RAST) SEED-based comparison, isolate 9610 was found to possess six unique genes.

Conclusion: These results support the identification of clinical isolate 9610 as a novel genome to the *T. forsythia* species. Importantly, this study identified the presence of valine-glycine repeat protein G (VgrG), a puncturing component of the type VI secretion system (T6SS) used by Gram-negative bacteria to deliver effectors into target cells via direct cell-cell contact. Further study is required to determine if isolate 9610 possesses other distinct components of the T6SS and, if so, how the T6SS is used

for microbial competition or pathogenesis.

Supported by: NIH R01DE023810, R01DE020102, T90DE021984, and University of Washington Dr. Douglass L. Morell Dentistry Research Fund

19. Timothee Cousin

The Influence of Spheno-Occipital Synchronosis Patency on Midfacial Growth

Cousin T, Khosravi R, Bui T, Curcio E, Vora S.

Orthodontics

Aims: Atypical growth at the spheno-occipital synchronosis (SOS) is thought to play a role in the pathogenesis of mild midface hypoplasia (MFH). Therefore, it is reasoned that SOS patency could be a more specific determinant of midfacial growth compared to generalized growth measured by chronological age. In this retrospective study, we examined the morphometric measurements of cranial base and maxillary in relationship to SOS patency using cone beam computed tomography (CBCT) records and 3D morphometric analysis.

Methods: CBCT scans of patient 5-11 years-old were obtained from a private orthodontic office database. SOS patency was determined using an established grading scale and 38 landmarks were plotted for each scan using 3D analysis software (Checkpoint). Linear and angular measurements were calculated for each patient. Regression analysis was then performed to assess measurements of cranial base and maxilla as a function of age. Changes in these measurements in various age groups stratified by a dichotomous SOS ossification status were also examined.

Results: 94 CBCT scans (38 male, 56 female; mean age=8.31) were landmarked and analyzed for SOS patency status. In general, posterior/anterior cranial base and maxillary length increased with age whereas maxillary projection increased only according to N-perpendicular to A-point, and not SNA. Children with fusing SOS ossification also displayed shorter maxillae, anterior and posterior cranial bases, as well as more retrusive maxillae compared to children with patent SOS.

Conclusions: These preliminary results suggest a trend that children who experience early fusion of the SOS display

shorter anterior and posterior cranial bases as well as mildly retrusive and shorter maxilla. More studies with a larger sample size and wider age range are needed to further support this trend.

Supported by: National Center for Advancing Translational Sciences of the National Institutes of Health under Award Number TL1TR000422. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

20. Dennis Wang

Application of Cyclical Strain in Farm Pigs

Wang DB, Herring SW, Rafferty KL
Orthodontics and Oral Health Sciences

Objectives: Previous studies have indicated that cyclical strain applied to normal sutures results in enlargement of the suture and increased numbers of osteoblasts at the sutural margins. However, it is unclear whether such treatment also affects distant sutures. The purpose of this study is to observe how cyclical loading at one nasofrontal suture affects the contralateral suture, coronal sutures, internasal suture, and interfrontal suture.

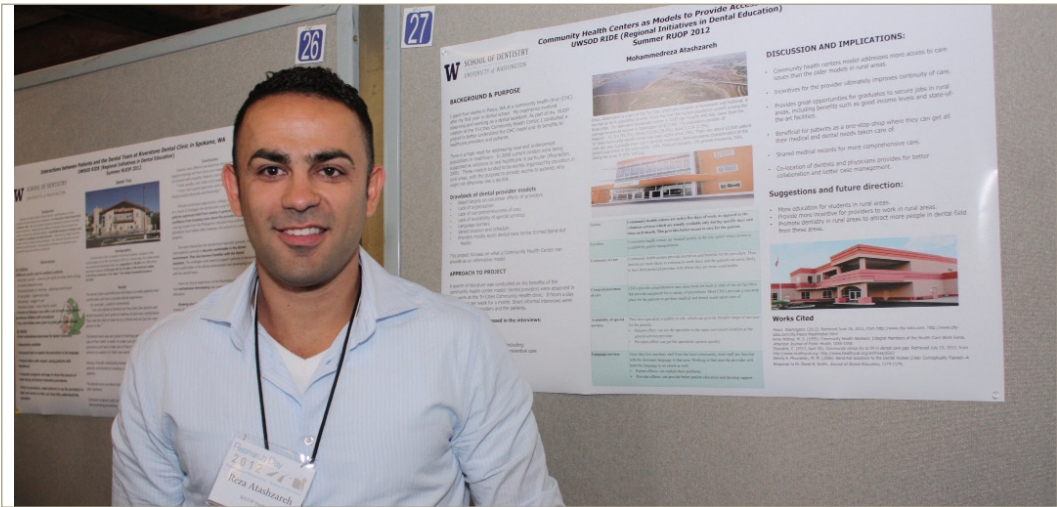
Materials and methods: Of 4 3-month old farm pigs, 1 was a sham and 3 were loaded. All animals had 1cm-projecting im-

plants placed surgically over the right nasofrontal suture. For 5 consecutive days, a load of 800-1000 tensile microstrain was cycled at a frequency of 2.5 Hz for 30 minutes (4,500 cycles/day). On day 5, strain data were collected with single element gages placed across both nasofrontal, both coronal, internasal, and interfrontal sutures using the MP150 system and Acqknowledge software (BIOPAC Systems, Inc.). Voltages were transferred into Microsoft Excel and converted to microstrain (percent deformation). Strain analysis involved measurement of peak strain minus baseline. All 150 cycles/min were measured and averaged.

Results: Sutures closer to the loading source displayed a higher magnitude of strain. Loaded nasofrontal sutures displayed the highest amount of tensile strain followed by the ipsilateral coronal sutures which displayed a high degree of compressive strain. Compared to the other sutures, the midline sutures, the internasal and interfrontal sutures experienced a lesser degree of strain.

Conclusions: Application of cyclical force to the nasofrontal sutures in farm pigs affects both nasofrontal sutures but also produces varying strain magnitudes and polarity at the other cranial sutures. Further investigation with histology will ascertain whether cyclical loading will widen sutures and increase mineral apposition at the bony fronts in this animal model.

Supported by: University of Washington Dr. Douglass L. Morrell Dentistry Research Fund, UW Orthodontics Alumni, and NIH R21DE024814.



21. Birkin Owart BoNT/A Masseter Muscle Injections Reduce Mandibular Condylar Bone Quality

Owart BR, Rafferty KL, Herring SW

Orthodontics

Objectives: We investigated the effect of Botulinum neurotoxin type A (BoNT/A) masseter muscle injections upon mandibular condylar bone quality. We hypothesized that these injections would generally decrease bone volume (BV), tissue volume (TV), as well as bone density (BD). This is important as BoNT/A injections are becoming increasingly offered by the dental profession for treatment of symptoms related to temporomandibular disorder, as well as for the cosmetic alteration of facial and masticatory muscles.

Methods: We utilized micro-computed tomography bone quality data in two experiments with a rabbit (*Oryctolagus cuniculus*) model. In the first experiment, individuals were unilaterally injected with either BoNT/A (n=13) or 0.9% saline (n=5) three times at 12-week intervals. In the second experiment, individuals received either a single BoNT/A (n=8) or 0.9% saline (n=8) injection bilaterally, and subsets of each group were sacrificed at either 4- or 12-weeks. 1mm (anterior-posterior) condylar cross-sections were analyzed for (BV), (TV), and (BD). Samples were considered as a whole, and in three subsections: subchondral, trabecular, and cortical.

Results: In the unilateral injection study, treated condyles had significantly reduced BV (29%), TV (21%), and BD (11%) relative to their contralateral side. For the bilateral injection study, BoNT/A treated individuals had a reduction of 5.6% in BD at 4-weeks. BD marginally increased at 12-weeks (3.8% difference). For both experiments, the trabecular region had the most dramatic reduction of BD: 37% (unilateral injection study); 14% at 4-weeks, and 3.2% at 12-weeks (bilateral injection study).

Conclusions: Overall, we observed significant alterations of condylar bone quality following BoNT/A masseter muscle injections. Consequences of reduced bone quality include osteopenia, susceptibility to fracture, and perhaps a more complicated temporomandibular disorder. Consenting patients should be made aware of possible musculoskeletal risks associated with BoNT/A injections as these treatments become more common in dental clinical practice.

Supported by: University of Washington Dental Alumni Association and NIH DE018142.

22. Mari-Alina Timoshchuk Neutron Radiation Efficacy When Treating Salivary Gland Malignancies

Timoshchuk M, Dekker P, Davis C, Laramore GE,
Dillon JK

Oral and Maxillofacial Surgery and Radiation Oncology

Objectives: Radiation therapy is commonly used to treat head and neck malignancies. While there is abundant research concerning photon radiation therapy, there is limited literature regarding oral complications following neutron radiotherapy (NRT). The aim of this study was to estimate the rates of: 1) 6-year locoregional control; 2) 6-year survival; and 3) oral complications in subjects with head and neck salivary gland malignancies treated with NRT.

Material and Methods: This is a retrospective cohort study. The sample was composed of patients with salivary gland malignancies treated with NRT between 1997 and 2010. Variables included patient demographics, tumor staging and characteristics, operative and pathological findings, NRT dosing, and complications. Data were extracted from patient charts and by telephone for follow-up and quality-of-life information. Univariate statistics were computed for each study variable and Kaplan-Meier methods were used to estimate locoregional control and survival rates. Statistical significance was set at $p < 0.05$.

Results: The sample was composed of 558 patients with a mean age of 54.2 years (± 16). Adenoid cystic carcinoma (47%) and parotid gland location (55%) predominated. Perineural and lymphatic invasion was present in 49% and 27% of subjects, respectively. The 6-year locoregional control rate and the 6-year survival rate was 73% and 72% respectively. Survival was associated with positive surgical margins ($p < 0.0001$), lymphatic invasion ($p < 0.0001$), perineural invasion ($p = 0.024$) and neck involvement ($p = 0.002$) Mucositis, xerostomia, and osteoradionecrosis occurred in 89%, 79%, and 3% of subjects.

Conclusion: When compared to conventional photon therapy (25%), NRT had an improved 6-year locoregional control (73%) and 6-year survival rate (72%). Positive surgical margins and lymphatic invasion were the most significant prognostic survival risk factors. The rates of oral complications for NRT were comparable to conventional photon therapy. This study is the largest study to date assessing the oral side effects and osteoradionecrosis rates (3%) for NRT treatment.

Supported by: University of Washington Dr. Douglass L. Morell Dentistry Research Fund

23. Kerry Streiff Increased Gustatory Sensitivity & Gingival Sensory Deficiency after Third Molar Extractions

Streiff K, Drangsholt M, Coldwell S

Oral Medicine

Objectives: Identifying etiologies of orofacial pain and sensory alterations introduces the potential for complete prevention of these symptoms. This study examined effects of 3rd molar extractions on neurosensory function by observing reactions to lingual and inferior alveolar nerve stimulation in subjects 18-30 years old.

Methods: Gustatory data were collected using a self-report computerized rating scale in response to sucrose, sodium chloride, citric acid, and quinine solutions. The tastants were applied bilaterally to the anterior tongue and through a whole-mouth trial to assess sweet, salty, sour, and bitter perception. Quantitative Sensory Testing, specifically Mechanical Detection Threshold (MDT), was performed using von Frey filaments (A-beta nerve fibers) bilaterally on the hand (control), tongue, and mandibular gingiva. Averages, standard error and t-tests were used to assess differences.

Results: Gustatory: Mandibular 3rd molar extraction group (n=11) showed significantly increased perceived intensity (%gLMS scale) on the anterior tongue (averaged right/left) for sodium chloride (25.3 vs. 17.5, $p=0.014$) and quinine (21.4 vs. 11.2, $p=0.002$) compared to non-extraction group (n=10). Whole mouth trials showed the same trend for increased perceived intensity for the 3rd molar extraction group across all tastants: sucrose (25.8 vs. 19.8, $p=0.143$), sodium chloride (38.1 vs. 30.3, $p=0.098$), citric acid (40.3 vs. 32.0, $p=0.145$), quinine (50.9 vs. 35.0, $p=0.009$). Participants with other mandibular extractions (n=4) exhibited results in between the two groups and were excluded from statistics.

MDT: Mandibular 3rd molar extraction group showed significant losses of gingival sensation when compared to non-extraction group (9.29 vs. 1.99 mN, $p=0.043$). The other extracted teeth group exhibited loss (4.27 mN) to a lesser extent than the 3rd molar group. Floor effect was observed for the tongue.

Conclusions: Healthy, asymptomatic participants with extracted mandibular 3rd molars simultaneously exhibited increases in perceived gustatory sensations and losses in mechanical detection for intraoral mandibular regions.

Supported by: University of Washington Dental Alumni Association and the Washington Dental Service Endowed Professorship

24. Julian Nghia Nguyen Evaluation of Nerve Damage following Local Anesthesia Exposure

Nguyen JN, Chandra S

Oral & Maxillofacial Surgery

Objectives: Local anesthetics are widely used in oral surgical and dental procedures along with many other disciplines. Although uncommon, it is known that temporary and permanent peripheral nerve damage does occur after exposure to these agents. The estimates of nerve involvement with local anesthetic injections vary by study, ranging from 1:750,000 injections to as many as 1:26,000 injections. Different local anesthetic agents have varying rates of reported injury. Prospective studies report paresthesia is associated with prilocaine and articaine in the most injuries. The exact mechanism of damage is unclear. Current hypotheses are injury from nerve contact with the injection needle, nerve sheath hemorrhage, anesthetic pressure build up from possible nerve injection site or simply cytotoxic effects from the anesthetic itself. Currently there is a deficit of studies to date that explore local anesthetic nerve damage and likely no current study that uses human tissue. The objective of this study is to observe cytotoxic damage from exposure to different local anesthetics on human multifascicular nerve tissue.

Methods: Sectioned samples of lingual nerve tissue from a fresh frozen cadaver is injected or submerged in lidocaine, prilocaine, articaine or mepivacaine solution for intervals of 0 min, 60 min or 6 hours. Damage is assessed by anatomic change in fascicles based on a scoring system from 0 to 4. Human nerve samples will be compared to both frozen and paraffin embedded pig cranial nerve tissue to assess freezing and thawing artifact damage. Results will also be assessed alongside excised samples donated from patients with nerve paresthesia, serving as an in vivo representation of clinical injuries. This study depicts the neuronal damage by varying type and exposure times of local anesthesia agents.

Results: The results of the study are ongoing and will be presented along with histopathological specimens.

Conclusions: The conclusions of the ongoing study will be presented with results.

Supported by: University of Washington Dr. Douglass L. Morell Dentistry Research Fund

25. Monique Luu

A Scoping Review of Epidemiologic Risk Factors for Pediatric Obesity

Chi DC, Chu F, Luu M

Oral Health Sciences

Objectives: Studies have identified risk factors for childhood obesity. The purpose of this scoping review was to develop a conceptual model to identify non-modifiable and modifiable risk factors for childhood obesity, and to illustrate how these findings are relevant in developing interventions aimed at preventing obesity and dental caries in children.

Methods: We searched PubMed and Embase and limited our study to English-language publications. A total of 2,572 studies were identified. After de-duplication, 2,479 studies remained and were downloaded into a citation-management tool. Two authors screened the titles and abstracts for relevance. Two-hundred-sixty studies remained and were retrieved for a full-text review and 80 studies were excluded, resulting in 180 studies included in the scoping review. We used inductive content analytic methods to organize all statistically significant obesity risk factors into seven domains, which were classified as non-modifiable or modifiable. Then, we developed a conceptual model of common risk factors associated with childhood obesity and caries.

Results: Non-modifiable obesity risk factors include biological and developmental (e.g., genes, developmental conditions, puberty), sociodemographic and household (e.g., race/ethnicity, socioeconomic status, parent education, unemployment), cultural (e.g., degree of acculturation), and community (e.g., neighborhood composition). Modifiable risk factors included behavioral (e.g., diet, physical activity, weight), psychosocial (e.g., maternal stress, family functioning, parenting practices, child temperament), and medical (e.g., parent smoking, maternal health, child health).

Conclusions: Identifying common risk factors has important implications for future oral health research aimed at preventing pediatric obesity and dental caries. Epidemiologic knowledge gleaned from the literature can be used to develop more rigorous interventions and programs aimed at preventing these highly prevalent diseases and improving health outcomes for children.

Sponsored by: University of Washington Dr. Douglass L. Morell Dentistry Research Fund



26. Elise Ellingsen

Dental Providers' Perceptions of Dentally Fearful Patients

Ellingsen E, Heaton L

Oral Health Sciences

Objectives: Throughout the United States and around the world, patients with dental fear have significant barriers to achieving good dental health. Dentally fearful patients often do not visit the dentist and thus do not receive proper oral healthcare. Currently, there is limited research that focuses on dental providers' perceptions of treating patients with dental fear. Therefore, the objective of this research was to determine how much training dental providers have in treating patients with dental fears and how satisfaction with training relates to providers' attitudes toward and perceptions of treating these patients.

Methods: The research involved a brief, eighteen-item survey, and was given to eligible participants (dentists, hygienists, assistants) attending the 2016 Pacific Northwest Dental Conference (N=199). The survey included questions to determine the amount of education providers received on treating dentally fearful patients, types of treatment management used primarily by providers (pharmacological vs. behavioral), and a Likert Scales to determine the amount of Satisfaction with Training and Attitudes providers have toward treating fearful patients.

Results: The results indicated no statistical significance between the amount of training and Attitude scores ($r=0.086$; $P=0.227$). There was a positive and significant correlation between the Satisfaction with Training scores and Attitude scores ($r=0.451$; $P<0.01$). Dental assistants reported sig-

nificantly higher (more positive) Attitude scores than dentists and hygienists ($F=3.39$; $P<0.01$). There was a positive correlation between Satisfaction with Training scores and both Pharmacological ($r=0.158$; $P=0.028$) and Behavioral scores ($r=0.145$; $P=0.043$), such that participants who were more satisfied with their training in treating fearful patients reported more use of both pharmacological and behavioral management techniques.

Conclusions: Finding methods to increase dental providers' satisfaction with training will help to improve the perceptions towards patients with dental fears and the treatment of these patients.

Funded by: University of Washington Dr. Douglass L. Morell Dentistry Research Fund

27. Michael Siew Perioperative Management of Head-and-Neck Cancer Patients among U.S. Maxillofacial Units

Siew MM, Chandra SR

Oral and Maxillofacial Surgery

Objectives: Evidence-based guidelines for perioperative management of head-and-neck cancer (HNC) patients are meager. There is a need to formalize protocols and standardize care using validated interventions that optimize patient outcomes and reduce healthcare costs. To do so, we aim to outline current practices in oncologic/microvascular reconstructive surgery among U.S. oral-maxillofacial units, review pertinent literature, and present a HNC clinical pathway.

Methods: U.S. oral-maxillofacial surgeons ($n=141$) from units performing oncologic/reconstructive surgery were surveyed on pre-operative, intra-operative, and post-operative care of HNC patients with multiple-choice, matrix, and free response questions. Descriptive analysis was performed.

Results: About 40% (57/141) responded. Of those, the following results were obtained. Preoperative: 94% participate in multidisciplinary team (MDT) care. 46% and 42% often/always use 4% chlorhexidine scrub and antibiotics for MRSA prophylaxis, respectively. Intraoperative: 48% often/always avoid using vasopressor; 35%, 25%, and 19% often/always use aspirin, low-molecular weight and unfractionated hepa-

rins during surgery, respectively. Post-operative: 77% often/always admit patients to the ICU; 65% often/always perform elective tracheostomies; flaps are often/always monitored clinically by 96% and using surface Doppler by 56%. The latter was the most common adjunctive method to monitor flaps. Use of hyperbaric oxygen therapy (HBOT) was variable.

Conclusion: Our survey is the only large-scale study of head-and-neck surgical care practices among U.S. oral-maxillofacial surgeons. There is consistency on use of MDTs, post-operative ICU care, elective tracheostomies, and clinical flap monitoring. There is variability regarding use of MRSA prophylaxis, anti-coagulation, vasopressors, and HBOT. More prospective clinical trials are needed to develop optimal clinical practices that improve outcomes, shorten length-of-stay, and reduce healthcare costs. A HNC clinical pathway designed by the senior author incorporating evidence-based interventions will be presented.

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OTHER DENTAL STUDENTS

28. Sarah McMartin

Patient Satisfaction Following Genioplasty: A Systematic Review

McMartin S, Khosravi R

Orthodontics

The chin plays an important role in the esthetics of the face. Various methods have been used to alter the chin including osseous genioplasty, alloplastic or soft tissue implants. Several studies have examined patient satisfaction after chin modification procedures, yet systematic reviews summarizing the available knowledge is lacking. This systematic review aims to assess postoperative patient satisfaction following genioplasty.

A literature search was performed in August 2016 using PubMed. Included studies were: clinical trials, retrospective studies, and case series/reports of patients of all ages that discussed patient satisfaction following a genioplasty procedure, alone or in conjunction with other orthognathic surgical procedures. The primary outcome assessed was patient satisfaction, including a numerical or verbal response scale. Secondary outcomes observed included pre and postoperative photographs, measurements, and or cephalometric radiographs. All search results were screened and the data was extracted.

We included 23 publications out of 70 identified reports. There were 2 RCT, 8 retrospective studies, 11 case-series, and 2 prospective studies. 16/24 publications evaluated patient satisfaction with numerical or verbal response scale. The remaining 8/24 papers mentioned data regarding patient satisfaction or dissatisfaction, but was not correlated to a questionnaire or survey. Our summary thematic analysis suggests that genioplasty has been found to be a highly satisfactory treatment for improving facial esthetics. Osteoplastic genioplasty has higher patient satisfaction, more reliable outcomes, and is a more versatile procedure. Alloplastic chin augmentation also has high patient satisfaction but is more limited in the amount it can modify the profile without causing detrimental effects. Some studies cited positive changes in self-esteem and quality of life. Common reasons for dissatisfaction were improper size or infection.

Overall, compelling evidence suggest that patients are highly satisfied with a genioplasty. Nonetheless, the primary source of evidence regarding patient satisfaction stems from case series and retrospective studies.

29. Alexa Ellingsen

Content Analysis of Tweets Produced by Invisalign's Twitter Account

Ellingsen A, Bosselut A, Khosravi R

Orthodontics, Computer Science and Engineering

Access to information has been simplified by Internet search engines and social media. Public and patients refer to social media to obtain information regarding dental healthcare. Companies providing new orthodontic treatment modalities have been directly targeting the public using social media. The content of information broadcasted by these companies through various social media as well as the demographics of interacting users is currently unknown. This study sought to determine the content of tweets relayed by Invisalign and the nature of user interactions with this account to understand the influence of social media in oral healthcare.

17,707 tweets were extracted from the Invisalign Twitter account over the span of January 2014 to November 2016. Mentioned accounts were categorized into: blogger, personal account, orthodontist, general dentist, wedding and fashion, and organization. The engagement index was then determined by the total number of mentions for each category. Hashtags were categorized into five themes: wellness, education, product advertisement, personal engagement and oral healthcare promotion. Only hashtags and usernames that appeared 10 times were included. Descriptive statistical analyses were then performed.

The Invisalign Twitter account mentioned 123 usernames, totaling 2,538 mentions. Organization category had the highest interaction with 998 mentions (39.3%). Wedding and fashion category were found to have the lowest interaction with 135 mentions (5.3%). Of the five hashtag categories, product advertisement and wellness contained the highest frequencies of hashtags at 42.2% and 40.8%, respectively. Education was utilized the least at 2.85%. Popular tweeting days were Monday-Friday, with fewer tweets on weekends.

Twitter is expanding its role into a platform for an interactive source of information. Our results suggest that Invisalign's usage of Twitter primarily reflects higher degrees of interaction with organizations and personal accounts. Their Twitter activities are also used largely for product advertisement and wellness promotion.

Supported by: Department of Orthodontics

30. Boden Slagle

Survey on Oral Health Related Quality of Life Questionnaires

Slagle B, Kotsakis G

Periodontics

In our study, we conducted a survey to assess the current utilization of OHRQoL measures by Periodontists, to determine how to develop brief but valid methods to facilitate the routine assessment of OHRQoL in daily practice in the future. We did this by conducting an Internet survey of members of the Midwest Society of Periodontology and the UW Alumni Club, with active practices in the United States. The survey was made and hosted on the website surveymonkey.com, and invitations were sent by email via this site. Periodontists currently practicing in the United States and who are part of these societies were invited to participate in this survey by e-mail with information about the nature of this study of OHRQoL in general, and clarification that it was a short (6 question) survey that would require very little of their time. A uniform resource locator link to access the questionnaire was provided. Completion of the survey implied their written consent, and the questionnaire could only be filled in once by each periodontist. The reported survey data were anonymous and confidential. The questions addressed: 1) demographics of the survey participants; with Q1 asking age, Q2 asking gender, Q3 asking years of periodontics practice, and Q4 asking what state their practice is located in. 2) questions regarding OHRQoL questionnaires specifically, structured as one question with multiple statements, each statement requiring either the selection of "Strongly Disagree", "Disagree", "Neutral", "Agree", or "Strongly Agree". We found that a majority of respondents (72.98%) do not currently use a questionnaire to assess OHRQoL in their practice, but we found that 69.09% of our respondents thought it would be feasible to incorporate a questionnaire with <10 OHRQoL items into their practice. We also found that 76.58% of our respondents would use an OHRQoL questionnaire if it was a scientifically proven to aid clinical decisions and was brief, easily available, and free of charge. Over half of our respondents, 54.96% agreed that assessing OHRQoL is of interest to their patients. 87.27% of our respondents also agreed that they were most interested in using a 5-item questionnaire over a longer, 49 item questionnaire.

From this, we can conclude that though using OHRQoL questionnaires is currently an uncommon practice, a majority of periodontists would be willing to use a short questionnaire

that screens for oral health problems, especially one that is scientifically proven to aid decision-making.

31. Divya Madhavan

Morita Accuitomo 170®: Streaking Artifacts from 6 Different Endodontic Materials

Madhavan D, Aps J

Oral Medicine (Oral and Maxillofacial Radiology)

Introduction: Streaking artifacts from radiopaque materials in the axial plane can significantly decrease the diagnostic quality of images of endodontically treated teeth.

Aim: To measure the dimensions in the axial plane of known prefabricated shafts in a Perspex block, filled with 6 different endodontic materials. Material and Methods: Perspex block prepared with 7 canals (2 x 2 x 20 mm): 6 filled with (1)Dentsply® gutta percha β phase (gutta percha points), (2) Dentsply® gutta percha α phase (Calamus Flow), (3)Dentsply AHPlus Jet® sealer, (4)Ivoclar Apexit Plus® sealer, (5)Dentsply ProRoot MTA®, (6)Septodont Biodentine® respectively. Morita Accuitomo 170® CBCT exposure combinations: 66, 76, 86 kV and 2,4,6,8,10 mA and 180° or 360° rotation arc. Morita i-Dixel® software was used by a calibrated researcher (DM) to measure M-D and B-L diameters of each canal. All measurements were repeated 10 times. All results were immediately put into an Excel database.

Results: Material (3) always created the greatest artifacts, while material (6) the least. Material (4) artifacts from 180° rotation were larger than at 360°. B-L measurements were significantly larger than M-D measurements ($P<0.0001$) irrespective of rotation arc. For 360° rotations: at 66 kV and 10 mA and 76 kV and 10 mA the B-L measurements were significantly larger than at 86 kV and 10 mA ($P=0.0087$ and $P=0.0364$); at 66 kV and 4 mA the M-D measurements were significantly larger than at 86 kV and 4 mA ($P=0.0068$); at 76 kV and 10 mA the M-D measurements were significantly larger than at 86 kV and 10 mA. For 180° rotations: at 66 kV and 4 mA the M-D measurements were significantly larger than at 76 kV or 86 kV and 4 mA ($P=0.0005$ and $P=0.0058$).

Conclusion: Different endodontic obturation materials result in different streaking artifacts. Bucco-lingual streaking tend to be significantly larger than mesiodistal streaking.

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