DALHOUSIE UNIVERSITY

FACULTY OF DENTISTRY

Focus on Research Day

Wednesday October 30th, 2024

1:00 PM to 6:00 PM

Lord Nelson Hotel

At a glance

Time	Event
1:00 PM	Venue opens
1:30 PM	Opening remarks
2:30 PM	Keynote address
3:30 PM	Posters & refreshments
4:15 PM	Trainee presentations
5:15 PM	Reception
6:00 PM	Event ends

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1:30 PM – Opening Remarks

Dr. Mark Filiaggi
Associate Dean, Research & Graduate Studies, Faculty of Dentistry

Dr. Ben Davis
Dean, Faculty of Dentistry

1:45 PM – Faculty Presentations   Moderator: Dr. Sachin Seth

Bridging the Gap: Tackling Affordability to Improve Oral Health through the 5A's of Access to Care
Prof. Abdulrahman Ghoneim
Assistant Professor, School of Dental Hygiene, Faculty of Dentistry

Special Care Dentistry
Dr. Tracy Doyle
Assistant Professor, Faculty of Dentistry, Staff Paediatric Dentist, IWK

Brushing Up on Mouth Care: Updates and Future Directions
Dr. Rebecca Affoo[1] & Prof. Shuana Hachey[2]
[1]Assistant Professor School of Communication Sciences and Disorders, Faculty of Health, [2]Associate Professor, School of Dental Hygiene, Faculty of Dentistry

Advancing Oral Health Over the Life-Course: From Unraveling Pathways to Informing Interventions

Dr. Noha Gomaa

Assistant Professor and the Associate Director for Dentistry Research at the Schulich School of Medicine & Dentistry, Western University

Biography

Noha Gomaa is an Assistant Professor and the Associate Director for Dentistry Research at the Schulich School of Medicine & Dentistry, Western University, and a Scientist at the Children's Health Research Institute in London, Ontario. Her research program investigates the connections between the social and psychosocial environment and oral health over the life-course, while evaluating the multi-level impacts of oral health care clinical and policy interventions. Noha completed her PhD at the Faculty of Dentistry, University of Toronto, followed by a clinician-scientist postdoctoral fellowship at the Hospital for Sick Children in Toronto. Taking special interest in knowledge mobilization, Noha currently serves on the National Advisory Group for the Chief Dental Officer of Canada and works with dental regulators on issues of oral health care policy and professionalism in dentistry. More recently, she has co-led the Knowledge Mobilization and Implementation Science theme on Canada's first National Oral Health Research Strategy. Noha is also Councillor-at-Large for the Canadian Association for Dental Research (CADR) and an editorial board member for the Journal of Dental Research (JDR), and Community Dentistry and Oral Epidemiology (CDOE).

3:30 PM – Posters and refreshments

Short break for posters and refreshments. See page 6 for the list of posters and page 8 for abstracts.

Development of a Mucoadhesive Hydrogel for Biofilm Oral Microbiota Transplants

Andrew Smith[1] and Brendan Leung[1, 2]

[1]School of Biomedical Engineering, Faculty of Medicine, [2]Department of Biomaterials & Applied Oral Sciences, Faculty of Dentistry

Therapeutic Ion Release from Soluble Glasses: A Novel Approach to Caries Prevention and Management

Christine Andrea[1] and Daniel Boyd[2]

[1]School of Biomedical Engineering, Faculty of Medicine, [1,2]Department of Biomaterials & Applied Oral Sciences, Faculty of Dentistry

Nitrate and the Oral Microbiome

Jacob Smith[1] and Leigha Rock[2]

[1] Master of Periodontics Program, Faculty of Dentistry [2]School of Dental Hygiene, Faculty of Dentistry

Ex Vivo and Clinical Evaluation of the Efficacy of Saliva Substitute Gels

Sormeh Mehrabi*[1,] Pierre-Luc Michaud[2], Vahid Adibnia[1]

*Faculty of Dentistry Research Fellowship Student, [1]Department of Biomaterials & Applied Oral Science, Faculty of Dentistry, [2]Department of Dental Clinical Sciences, Faculty of Dentistry

Comparative Analysis of the Physico-Chemical Properties of Collagen-Based Barrier Membranes

Ahmed Al-Kayyali*[1], Lauren MacRae[2], Farmehr Asfzadeh[1], Locke Davenport Huyer[3,4,6], Zeeshan Sheikh[2,3,4,5]

*Faculty of Dentistry Research Fellowship Student,[1] Faculty of Dentistry [2] Faculty of Science, [3]School of Biomedical Engineering, Faculty of Medicine, [4]Department of Biomaterials & Applied Oral Sciences, Faculty of Dentistry, [5]Department of Dental Clinical Sciences, Faculty of Dentistry, [6]Department of Microbiology & Immunology, Faculty of Medicine

Closing Remarks & Awards

Dr. Mark Filiaggi

5:15 PM – Reception

Evening reception with food and non-alcoholic drinks.

#	Posters
1	**Traumatic Dental Injury in Patients with Autism Spectrum Disorder with and without Global Developmental Delay/Intellectual Disability** Jarrett Miller, Annika Nobbe, Tracy Doyle, Shannon Fitzpatrick, Pierre-Luc Michaud, Isabel Mello, Erin Quigley, Parisa Ghanouni (see page 8)
2	**Traumatic Dental Injuries Among Patients with Autism Spectrum Disorder and Comorbid Attention Deficit Hyperactivity Disorder** Annika Nobbe, Jarrett Miller, Tracy Doyle, Shannon Fitzpatrick, Pierre-Luc Michaud, Isabel Mello, Erin Quigley, Parisa Ghanouni (see page 10)
3	**Ex Vivo and Clinical Evaluation of the Efficacy of Saliva Substitute Gels** Sormeh Mehrabi, Pierre-Luc Michaud, Vahid Adibnia (see page 12)
4	**3D printed titanium constructs for maxillofacial applications** Lauren MacRae, Farmehr Asefzadeh, Pierre-Luc Michaud, Zeeshan Sheikh (see page 13)
5	**Dose optimization of perioperative methylprednisolone in orthognathic surgery – Post-operative opioid use and pain-related outcomes.** Matthew Kelvey, Amr Alsabbagh, Jean-Charles Doucet (see page 14)
6	**Periodontal Disease and Cognitive Impairment- A Systematic Review** Joseph Linder, Isha Verma, Yuqi Wang, Violet D'Souza (see page 15)
7	**Development of Bioactive Nanofibers for Tissue Engineering and Dental Applications** Malek Mahmoud, Hessam Koopaee, Rahimeh Rasouli, John Frampton, Vahid Adibnia (see page 16)
8	**Using Retrieval-Augmented Generation for a Dental Materials ChatGPT** M.G. Rocha, T. Price, R. Price

#	Posters cont'd
9	**Chitosan-Based Lubricating Hydrogel for Protecting Cartilage from Mechanical Wear** William Austin, Sam Selmani, Abdelatif Chenite, Eugenia Kumacheva, Xavier Banquy, Vahid Adibnia (see page 17)
10	**The Use of Single Dose vs Short-Term Perioperative Cefazolin in the Prevention of Surgical Site Infection Following Orthognathic Surgery** Breanna Bodle, Curtis Gregoire, Abdul El-Rabbany (see page 18)
11	**Program of Research** Leigha Rock, Associate Professor and Director, School of Dental Hygiene, Faculty of Dentistry leigharock.com
12	**Comparative Analysis of the Physico-Chemical Properties of Collagen-Based Barrier Membranes** Ahmed Al-Kayyali, Lauren MacRae, Farmehr Asfzadeh, Locke Davenport Huyer, Zeeshan Sheikh (see Page 19)
13	**Evaluation of cleft adjacent canine eruption in patients with cleft lip and palate treated with early secondary alveolar bone grafting** JC Doucet, Manan Patel, Kathy Russell (see page 20)
14	**Bio-Sourced Nanoparticles Modified with Antifouling Groups** Maya Goldchtaub, Vahid Adibnia (see page 21)
15	**Program of Research - The Oro-Systemic Pathways (OSP) Lab** Anjali Bhagirath, Assistant Professor, Department of Dental Clinical Sciences, Faculty of Dentistry (see Faculty profile)

Traumatic Dental Injury in Patients with Autism Spectrum Disorder with and without Global Developmental Delay/Intellectual Disability

Jarrett Miller[1], Annika Nobbe[1], Tracy Doyle[2], Shannon Fitzpatrick[2], Pierre-Luc Michaud[2], Isabel Mello[2], Erin Quigley[3], Parisa Ghanouni[4]

[1]DDS Student, Faculty of Dentistry, Dalhousie University, [2]Department of Clinical Sciences. Faculty of Dentistry, Dalhousie University, [3]Department of Developmental Pediatrics, IWK Health Centre, [4]Department of Occupational Therapy, Faculty of Health, Dalhousie University

Introduction: Dental trauma can include crown fractures, crown/root fractures, concussions, subluxations, luxations and avulsions, with the majority of TDIs occurring before 19 years of age[1]. It is estimated that over one billion people have experienced a traumatic dental injury (TDI)[2]. Autism spectrum disorder (ASD) presents with social deficits, repetitive/restrictive behaviors, limitations, or impairments in daily functioning and often other comorbidities[3]. Intellectual disability (ID) and global developmental delay (GDD) can be comorbid with ASD. ID presents with intellectual and adaptive functioning deficits, while GDD refers to those who are not meeting developmental milestones in many aspects of intellectual functioning but cannot take part in standardized intellectual testing due to young age or cooperation[3]. It has been suggested that those with ASD have a higher risk for severe TDI[4]. Additionally, literature on TDI in those with ID/GDD is limited. We aim to determine the incidence and type of TDI in patients with ASD at the IWK Children's Hospital in Halifax, Nova Scotia. We also aim to characterize associations between the rate of TDI in those with or without comorbid ASD and GDD and/or ID.

Methods: Study design consisted of retrospective chart review. A list of patients with ASD who were referred to the Early Intensive Behavioral Intervention (EIBI) program was received. Inclusion criteria was as follows: patients with ASD aged 3-15 who were seen in dentistry between January of 2016 and January of 2024. Initial review was conducted using paper and electronic charts to determine if patients were seen in the IWK dental clinic. Participants who fit inclusion criteria were further reviewed to determine presence of TDI, as well as other medical/dental variables. Data analysis was completed. For data comparing those with ASD alone and those with comorbid ASD and GDD/ID, patients who presented with an additional diagnosis of ADHD/ADD were excluded, as some studies point towards ADD/ADHD being a potential risk factor for TDI.

Results: A total of 1084 patients were screened and 434 participants met the study inclusion criteria. We identified 37 TDI and 397 non-TDI, with an overall frequency of 8.53%. The majority of TDI participants fell within the 3-5 year old age range. The majority of non-TDI participants were in the 6-8 year old age range. 330 males and 104 females met inclusion criteria, with 27 TDI in males and 10 in females. Enamel-dentin fracture and concussions were the most common hard and soft tissue injuries, respectively. Seven participants with TDI presented with ASD and GDD/ID while 15 participants with TDI presented with ASD alone. 185 non-TDI participants presented with ASD alone compared to 115 with comorbid ASD and GDD/ID. Frequency of TDI in those with GDD/ID was lower than in those with ASD alone, but the result was not significant at $p < 0.05$.

Conclusion: The findings in this study are similar to what is reported in literature. Frequency of TDI in those with ASD falls between the reported range of 4.6-25.7%[5-8]. Furthermore, rate of TDI in this sample is within the

range of 6-59% that is reported for the general population of children amongst literature[9]. Studies on this topic vary in design and study population, which could explain the large range seen here. Literature on the presence of TDI in those with ASD and comorbid GDD/ID is limited, and further studies focusing on this population would be beneficial.

References

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Traumatic Dental Injuries Among Patients with Autism Spectrum Disorder and Comorbid Attention Deficit Hyperactivity Disorder

Annika Nobbe[1], Jarrett Miller[1], Dr. Tracy Doyle[2], Dr. Shannon Fitzpatrick[2], Dr. Pierre-Luc Michaud[2], Dr. Isabel Mello[2], Dr. Erin Quigley[3], Dr. Parisa Ghanouni[4]

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Introduction: Traumatic dental injuries (TDIs) are injuries to the hard tissues of the teeth and/or periodontium caused by sudden, often accidental, impact[1]. TDIs are common, with approximately 33% of children and 25% of adults and adolescents experiencing dental trauma in their lifetime[1]. Research on TDIs in children with autism spectrum disorder (ASD) has been inconclusive[2,3]. Many children with ASD also have comorbid diagnoses, such as attention deficit hyperactivity disorder (ADHD)[4], with studies indicating that 32.8–59% of children with ASD also have ADHD[5,6]. Our primary objective is to determine the rate of TDI and age/sex demographics of children with ASD seen at the IWK Dentistry Department (IWK DD). The secondary objective is to examine how comorbid ADHD changes TDI rates in these children.

Methodology: A retrospective chart review was conducted using hospital patient identification numbers, online charting software and paper charts. Our overall study population came from referrals to Early Intensive Behavioural Intervention (EIBI), an ASD preschool program at the IWK Health Centre. From January 2016 to January 2024, 434 of the 1083 children referred to EIBI, aged 3-15 years old, were treated at the IWK DD (76% male). As part of a larger, unpublished study, we examined how comorbid ADHD affects TDIs in children with ASD. The sub-study consisted of two groups: those with ASD without comorbid ADHD (ASD only) and those with ASD and comorbid ADHD, regardless of other comorbidities (ASD+ADHD). This review identified 430 children (324 ASD only, 106 ASD+ADHD).

Results: Of the 434 patients treated at the IWK DD, 37 had experienced TDIs (8.53%). The overall TDI group was 73% male, with a mean age of 6.26 (SD = 2.3), while the non-TDI group was 76% male, with a mean age of 7.46 (SD = 2.3). In the sub-study population, there were 36 TDIs total: 22 were in the ASD only group (61.1%, 77% male, mean age = 5.71 (SD = 2.2)) and 14 were in the ASD+ADHD group (38.9%, 64% male, mean age = 7.01 (SD = 2.4)).

Conclusion: The high percentage of males in our overall population aligns with findings that males are four times more likely to be diagnosed with ASD than females[7]. The TDI rate in children with ASD is consistent with what has been found in the literature[8,9]. The TDI group was younger than the non-TDI group. The TDI rate in the ASD+ADHD group indicates that comorbid ADHD may affect TDI rates in children with ASD due to the relatively high rate and young age of the patients, which may suggest fewer ADHD diagnoses at the time of TDI. The ASD+ADHD group had a higher percentage of females and an older mean age compared to the ASD only group.

References

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Ex Vivo and Clinical Evaluation of the Efficacy of Saliva Substitute Gels

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Introduction: Xerostomia, or dry mouth, affects over 20% of the population and is commonly associated with reduced saliva production or altered composition due to salivary gland dysfunction. Saliva's pseudoplastic properties, largely due to mucins, play a crucial role in oral lubrication. Current therapies for xerostomia, such as artificial saliva formulations, often suffer from limited tissue adhesion, inadequate lubrication, and short durations of action. This study evaluates the rheological properties of four commercially available saliva substitute gels, aiming to determine their potential for enhancing lubrication and adhesion to oral tissues.

Methods: Four commercially available gels were selected based on formulation. Lipid formulation: Pure Coconut Oil. Two polymeric formulations: Biotene® Dry Mouth Gel and AllDay® Gel. Polymeric and botanic formulation: Oralieve® Gel. Polymeric and lipid formulation: Xerostom®. Rheological testing was performed using a Discovery HR 10 rheometer at 37°C with a 40 mm parallel plate geometry and a gap of 1000 μm. Three tests were conducted: oscillation-time sweep, oscillation-frequency sweep, and oscillation-amplitude sweep. These tests evaluated the time-dependent stability, viscoelasticity, and structural integrity of the gels under varying strains and frequencies.

Results: Xerostom® exhibited the highest storage modulus (G′), indicating a strong network structure and high elasticity. Biotene® demonstrated a moderate balance between elasticity and flexibility. Oralieve® and Allday® showed weaker structural integrity, with Coconut oil behaving more like a viscous liquid, lacking a strong network. Frequency sweep results revealed that Xerostom® and Biotene® maintained their structural integrity across different shear conditions, whereas Coconut oil displayed a more pronounced flow behavior.

Conclusion: Xerostom® and Biotene® emerged as the most structurally resilient gels, showing high resistance to deformation and enhanced elasticity, making them suitable for applications requiring prolonged structural integrity. Oralieve® and Coconut oil, while more fluid, may be more appropriate for scenarios where ease of flow is prioritized over rigidity. These findings provide key insights into optimizing saliva substitute formulations for managing xerostomia.

3D printed titanium constructs for maxillofacial applications

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Introduction: Maxillectomies are resective surgical procedures reserved for treatments of maxillary malignancies, or in certain cases of infections or trauma. Following the resection, reconstruction of the maxilla is often a long and arduous surgical procedure associated with an increased risk of donor site morbidity, infection, and failure. As such, alternative biomaterials such as PEEK and titanium are investigated for their reconstructive potential. Titanium has high osteoconductivity, is corrosion resistant, has a high strength-to-weight ratio, and can be 3D printed into suitable implants shapes for the maxillae. This project aims to develop an optimal titanium mesh construct for future coating with bioresorbable calcium phosphates.

Methods: The characterization of 3D printed titanium mesh constructs is a crucial step in optimizing their design and performance. The unique properties of each titanium mesh, including strut lengths and thicknesses, grid designs, and internal cell volume, can significantly impact their mechanical behavior, biocompatibility, and overall functionality. Eight titanium mesh structure designs were created in collaboration with biomedical engineers and were slated for manufacturing via 3D printing. The designs had either 500μm or 1000 μm spacing between the struts, a 5mm or 10mm diameter, and an octagonal or grid-like pattern, for a total of eight different permutations for the mesh structures. The physical and chemical properties of the titanium mesh structures were determined using a series of imaging and structural analysis techniques. X-ray Diffraction (XRD) and Energy Dispersive X-ray Spectroscopy (EDS) were used to ensure a comprehensive analysis of the titanium mesh structures' crystalline structure and phase composition. Field Emission Scanning Electron Microscopy (FESEM) was used to examine the titanium mesh structures' detailed morphology and topography, allowing for microscopic and macroscopic analysis. FESEM imaging provided high-resolution images at a range of magnifications, from 30x to 20,000x, for the eight titanium sample types, which was essential to capture detailed views of the mesh structures' top and side surfaces. Lastly, Energy Dispersive X-ray Spectroscopy (EDS) was performed on the same FESEM system to provide a semi-quantitative analysis of the elemental composition of the mesh surfaces.

Results: Thus far, the characterizations have thoroughly evaluated the titanium mesh structures and offered more detailed insights into their structural integrity and chemical composition. The titanium utilized in the study was identified as Ti6Al4V, a commonly employed titanium alloy. Scanning Electron Microscopy (SEM) imaging revealed the presence of residual powder on the lattice structures, necessitating a thorough cleaning process to ensure optimal performance. The next steps would involve coating the samples with calcium phosphate coatings and implanting them into relevant animal models of maxillectomy.

Dose optimization of perioperative methylprednisolone in orthognathic surgery – Post-operative opioid use and pain-related outcomes

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Introduction & objective: Perioperative systemic corticosteroids are a long-standing and well-supported surgical intervention used to reduce post-operative pain and swelling. Post-operative pain and facial swelling are two acute sequelae of orthognathic surgery which lead to longer hospital stays, increased post-operative discomfort, and may prolong difficulties with speech and oral intake. While perioperative corticosteroids are widely used as the standard of care to reduce these cardinal signs of inflammation, there is limited evidence and a lack of consensus among surgeons for optimized corticosteroid regimens which balances the steroid-related adverse effects with their desired anti-inflammatory effects. The aim of this study was to determine whether patients receiving 1000mg of methylprednisolone have reduced post-operative opioid use or pain related outcomes compared to patients receiving 125 mg dose.

Methodology: This was a retrospective cohort study which used a convenience sample from a randomized control trial assessing the effect of personalized opioid prescription following orthognathic surgery. Participants from the control group received the standard post-operative analgesia regimen utilized at Dalhousie's Department of Oral and Maxillofacial Surgery. They were then stratified into two cohorts: "low steroid dose" (125 mg) and "high steroid dose" (1000 mg), based on the single preoperative methylprednisolone dose administered intravenously at the time of surgery. The primary outcome assessed was post-operative opioid use, with secondary outcomes being self-reported daily pain scores and surgical satisfaction. Differences between groups were compared using Mann-Whitney U test, and $P\_<0.05$ was considered significant.

Results: 73 total participants were included, 62 participants receiving the "low steroid dose", and 17 receiving the "high steroid dose". There was no statistically significant difference (P = 1.00) in total post-operative opioid use among participants receiving either 125mg or 1000mg of perioperative methylprednisolone. Further stratifying opioid use into "24-hour post-operative" and ">24-hour post-operative", there was no significant difference (P = 0.761 and 0.831 respectively). No statistically significant differences were observed in self-reported daily pain or surgical satisfaction scores.

Conclusion/significance: High dose methylprednisolone did not appear to have an added benefit to post-operative opioid use, or other pain-related outcomes, compared to a lower dose of 125mg. These findings coincide with previous literature and support the use of 125mg methylprednisolone as an effective dose for managing post-operative pain in orthognathic surgery.

Periodontal Disease and Cognitive Impairment- A Systematic Review

Joseph Linder[1], Isha Verma[2], Yuqi Wang[3], Violet D'Souza[3]

[1]Neuroscience Student Year 3, Dept of Psychology and Neuroscience, Dalhousie University; [2]Master Student in Global Health Year 1, Faculty of Health Science, McMaster University; [3]Faculty of Dentistry, Dalhousie University.

Background: Dementia is an acquired severe cognitive impairment that interferes with social and occupational functioning. It is a significant cause of increased disability among older adults. The number of people with dementia is expected to triple by 2050. Therefore, identifying and managing the key exposure factors of dementia may help reduce dementia-related burden. Periodontal disease, the second most common oral disease and a significant cause of tooth loss, is associated with cognitive impairment. However, the biological mechanisms explained to date are unclear. This systematic review investigates if periodontal disease increases the risk for cognitive impairment in adults.

Methods: In communication with the liaison librarian, we systematically searched the electronic databases EBSCO, Embase, CINHAL, EMBASE, PsycINFO, and PubMed and identified articles published in English from January 2000 to June 2024. All identified articles were imported to Covidence and systematically screened by four reviewers to determine their eligibility for inclusion. Studies that investigated the causal relationship between periodontal disease (exposure) and cognitive impairment (outcome) in humans and had at least 50 participants ≥50 years were included. Data were extracted from the potentially eligible studies.

Results: Of the 2183 identified articles, 25 met the inclusion criteria, pending quality assessment. All were population-based longitudinal studies: seventeen prospective and eight retrospective cohort studies. Fifteen were conducted in Asia, six in the United States of America, and four in Europe. Most (92%) studies found evidence to support that periodontal disease increases the risk for cognitive impairment in older adults.

Conclusion: Poor periodontal health appears to increase the risk of cognitive decline. Improving access to dental care services and preventing and managing periodontal disease may help manage the dementia-related burden.

Development of Bioactive Nanofibers for Tissue Engineering and Dental Applications

Malek Mahmoud[1], Hessam Koopaee[2], Rahimeh Rasouli[2], John Frampton[2], Vahid Adibnia[3]

[1]Microbiology & Immunology, Faculty of Science, [2]School of Biomedical Engineering, Faculty of Medicine, [3]Department of Biomaterials and Applied Oral Science, Faculty of Dentistry

Biological tissues are generally anisotropic and consist of long-range macromolecular fibers that many engineered materials strive to mimic. These structures closely replicate natural properties of a tissue and are important in relation to tissue engineering, 3D printing and dentistry. Creating nanofibers that closely resemble the physical and chemical features of biological tissues, despite advancements in designing bioactive polymers has been a challenge. This study seeks to fill this gap by studying the manufacturing and testing of nanofibers via the use of polyethylene oxide (PEO) in distilled water for dental purposes and tissue engineering. Centrifugal spinning and contact drawing methods have been employed to develop PEO nanofibers. Solutions of PEO with different concentrations (5 - 10%) were prepared and spun at different speeds. In the case of centrifugal spinning, speeds were between 3000 - 9000 RPM, while contact drawing utilized speeds of 200 - 500 mm/s. ImageJ software was used for data analysis & fiber morphology was determined using Scanning Electron Microscopy (SEM) and Brightfield Light Microscopy. Centrifugal spinning produced fiber diameters of between 250 to 450nm, while contact drawing fibers ranged from around 1300 to 2400nm. This implies that centrifugal spinning is more reliable than contact drawing because it can produce much thinner fibers on a continuous basis, hence it can be applied where fine fibers are needed. The study concludes that among methods of generating thin nanofibers, centrifugal spinning is ideal when comparing it with contact drawing technique, which may be more applicable in making thicker fibers. For fabricating tissue-like fibers with specific diameters, the ability to control their size is important. These results provide insights into fiber optimization in both tissue engineering and dental applications, as well as into importance of employing the appropriate manufacture processes according to a specific fiber goal. Future studies will focus on more specific experiments, utilizing the addition of Laponite and various salts into PEO solutions, to enhance the reliability of laboratory manufactured fibers among other conditions.

Chitosan-Based Lubricating Hydrogel for Protecting Cartilage from Mechanical Wear

William Austin[1], Sam Selmani[2], Abdelatif Chenite[2], Eugenia Kumacheva[3], Xavier Banquy[4], Vahid Adibnia[1]

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Background: Osteoarthritis (OA) is a silent disease on the rise and is the primary cause of adult disability globally[1]. Cartilage degradation can occur from both biochemical degradation and mechanical wear of the joint[2]. At early stages of OA, hyaluronic acid (HA) viscosupplements are used for treatment; however, these supplements only provide short term pain relief, and do not protect the joint from mechanical wear[3]. This is a result of enzymatic degradation of HA in the OA joint[4], the inability for HA to adhere to cartilage, and poor lubricating properties of HA[5]. In this project, we develop a next generation viscosupplement that surpasses the limitations of current viscosupplements in the market.

Methods: The next generation hydrogel is composed of highly hydrated polymers of carboxyl-modified chitosan (CMC, extracted from shrimp shells, modified, and purified in our laboratory)[6] crosslinked with aldehyde-modified glycogen (aGly, extracted from sweet corn kernels, modified, and purified in our laboratory)[7]. The composition of polymers in the gel is perfected to be a self-healing injectable hydrogel. The mechanical properties of the gel are measured using a rheometer. *In vitro* evaluation of the hydrogel cytotoxicity is completed on chondrocyte cells, while its *in vivo* efficacy was tested using rat's anterior cruciate ligament transection OA model. Degradation and swelling properties were also assessed.

Results: The resulting hydrogel indicates self-healing properties due to its reversible crosslinking through imine bonds, which makes the hydrogel injectable. Comparison of rheological properties of this hydrogel with the state-of-the-art viscosupplements currently available in the market (Synvisc® and Monovisc®) demonstrated that this hydrogel stores energy and provides a cushion under increased force. Rat OA models show that when treated with our hydrogels, degradation of cartilage in OA joints is significantly reduced compared to Synvisc® and Monovisc® as indicated by topographical micro-indentation experiments. Degradation studies show increased swelling and slower degradation in PBS 1X and serum-free culture media compared to Synvisc® and Monovisc® and decreased swelling and faster degradation in synovial fluid and culture media with serum compared to Synvisc®.

Conclusion: The injectable hydrogel designed in this study has the potential to replace current HA-based viscosupplements as it provides superior lubrication properties *ex vivo* and protects cartilage in OA joints *in vivo*.

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The Use of Single Dose vs Short-Term Perioperative Cefazolin in the Prevention of Surgical Site Infection Following Orthognathic Surgery

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Background: Orthognathic surgery describes a group of procedures whose main goal is to correct congenital and acquired dentofacial deformities. Functional and aesthetic outcomes may be achieved by surgical repositioning of the maxilla and mandible using a variety of methods. As access for these methods involves trans-oral approaches, these procedures are considered to be clean-contaminated surgeries due to the high intra-oral bacterial load. As a result, surgical site infection (SSI) rates are reported in the literature to range from 10-15% following orthognathic surgery. SSIs can lead to patient discomfort, prolonged hospital stays, increased morbidity, and higher healthcare costs. The use of peri-operative antibiotics has been demonstrated to significantly reduce the incidence of SSI following orthognathic surgery. However, antibiotic stewardship is essential to ensure that the use of these medications is optimized, avoiding overuse. Some protocols suggest a single pre-operative dose, while others recommend an extended course. Effective stewardship, therefore, aims to balance the prevention of SSIs with minimizing unnecessary antibiotic exposure, but more research must be done to reach a definitive protocol.

Methods: This randomized controlled study is being undertaken to determine the effectiveness of a single pre-operative dose (protocol A) vs 24-hour peri-operative IV cefazolin (protocol B) in preventing surgical site infection following orthognathic surgery, in particular following bilateral sagittal split osteotomy. Patients will return for follow-up at 2 weeks, 4 weeks, and 6 weeks following discharge. Surgical site infection diagnoses were made according to the CDC criteria and reported as either superficial, deep, or organ/space infections.

Results: Preliminary results include 90 patients with a mean age of 27.1 (± 10.09) comprising 58 females and 32 males. A Chi-square test was performed resulting in a p-value of 0.104 indicating no significant difference in the rate of surgical site infections between protocol A and protocol B. After full data collection, chi-square tests and generalized linear mixed effect models will be implemented to further determine statistical significance and correlation.

Conclusion: The initial results indicate that there may be no need for peri-operative antibiotic administration. Ultimately, this study has the potential to enhance clinical guidelines and optimize patient care in orthognathic surgery.

Comparative Analysis of the Physico-Chemical Properties of Collagen-Based Barrier Membranes

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Introduction: Guided Bone Regeneration is a surgical technique to promote the growth of new bone in areas where it has been damaged or resorbed. The main challenge in Guided Bone Regeneration (GBR) is gingival epithelial cell migration into the defect space and thus they occupy the space hindering bone regeneration (Wessing et al., 2018). Barrier membranes are used to help maintain the defect space for regenerating bone that would otherwise be occupied by epithelial cells. The surface chemistry of the membrane, where protein adsorption occurs before cell recruitment and adhesion, plays a critical role in the inflammatory and wound-healing responses to implanted membranes. In this study, we aim to characterize the physico-chemical properties of six commercially available membranes to appreciate differences that define their success in the clinic.

Methods: Six membranes using clinically including five that were collagen based: BioGuide, MucoGraft, FibroGuide, Agile +, OsteoShield Collagen and one made of polytetrafluoroethylene: (OsteoShield PTFE) were subjected to in depth material characterization. Membrane characterization was performed through Scanning Electron Microscopy (SEM), Energy-Dispersive X-ray Spectroscopy (EDS) to determine the elemental composition, X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) to identify materials based on the arrangement of atoms and molecular vibrations respectively, Confocal Laser Scanning Microscopy (CLSM) to determine the roughness of materials and Contact Angle Analysis to measure wettability using ImageJ.

Results: Collagen based membranes were determined to have similar elemental composition using EDS except for Mucograft which contained NaCl crystals. This is also showcased in XRD where Mucograft's arrangement of atoms aligned with NaCl salt in the daabase. FibroGuide exhibits higher porosity as shown in SEM, and XRD analysis further depicts it lacking a well-defined crystalline structure. Wettability analysis of collagen membranes was 100% in all collagen membranes except for Agile +, which had a contact angle of 73°, making it relatively less hydrophilic to other collagen-based membranes. PTFE was highly hydrophilic with a contact angle of 112.5°. We expect observed different surface properties could lead to differential cell interaction and will investigate this behaviour in future work.

Evaluation of cleft adjacent canine eruption in patients with cleft lip and palate treated with early secondary alveolar bone grafting.

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Background and purpose: Alveolar Bone Grafting (ABG) is normally required in patients with UCLP or BCLP for reconstruction of the alveolar cleft. Precious in 2009[1] advocated for early secondary ABG and showed successful and predictable results that allowed for eruption of permanent incisors adjacent to the cleft and a more normal periodontal architecture. No studies to date have been published to assess definitive eruption of the cleft adjacent canines in the patients who underwent early secondary ABG. The aim of this study is to retrospectively evaluate cleft adjacent canine eruption in patients who underwent early secondary ABG (between 5 and 7 years of age).

Method: This retrospective study included patients with cleft lip and alveolus, or cleft lip and palate (unilateral or bilateral) consecutively treated with early secondary ABG or late secondary ABG during a 10-year period at the IWK Health Center in Halifax, Nova Scotia, Canada. The primary outcome of this study was to identify the status of cleft adjacent canine teeth eruption through the grafted site. Secondary outcomes included need for regrafting, need for pre-graft expansion and status of the cleft lateral incisor. The primary and secondary objectives were assessed based on previous radiographic imaging and examination findings. Categorical variables were compared with Pearson Chi-Square and Fisher Exact tests, and $p < 0.05$ was considered statistically significant.

Results: During the 10-year evaluation period, 152 ABG (125 early and 27 late ABG) were performed in 121 patients. The age at time of ABG differed significantly between the 2 groups with a mean age of 73.5±5.0 months for the early ABG group vs 113.4±32.0 months late ABG group (p<0.001). None of the patients required pre-graft expansion. The cleft diagnosis distribution was similar (p=0.686). The overall need for regrafting was 1.3% and did not differ between the groups (1.6% vs 0%; p=0.675). The cleft adjacent canine spontaneously erupted in 84.0% of the early ABG vs 70.4% of the late ABG group. Close to twice as many canines required surgical exposure (9.6% vs 18.5%) or extraction (6.4% vs 11.1%) in the late ABG group, but this difference was not statistically significant (p=0.183).

Conclusions: Early secondary ABG, without pre-graft expansion, does not compromise the eruption of the cleft adjacent canine compared to patient with cleft treated with late secondary ABG.

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Bio-Sourced Nanoparticles Modified with Antifouling Groups

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Phytoglycogen (PhG) nanoparticles (NPs) are inexpensively and commercially purified from sweet corn. They are non-toxic, monodispersed with a hydrated diameter of 80 nm, biodegradable, and exceptionally hydrated. These biosourced NPs are newly emergent within the biomedical field, but a rapid rush to apply PhG NPs to various applications, including lipophilic drug delivery, vaccines, gene therapy, is occurring [1].Just like other NPs, however, PhG NPs are prone the formation of protein coronas. A protein corona is a layer of serum proteins that have become adsorbed onto the surface of a NP through non-specific interactions such as electrostatic interactions. Protein coronas screen the surface of NPs, altering their functionality. Herein, we introduce a Phosphorylcholine (PC) modified PhG NP as a candidate for an antifouling NP. PC is a non-toxic, zwitterionic group that is present in the biological environments in abundance. For example, it is the zwitterionic functional group of lipid bilayers in mammalian cells. Zwitterionic groups have both positive and negative charges in close proximity. Water molecules readily associate with these charges, creating a layer that prevents protein corona formation [2]. Covalent modification of PhG NPs with PC was achieved via an ethylenediamine (EDA) bridge through imine chemistry. Dynamic light scattering measurement of Zeta potential (a measure of surface charge) and nuclear resonance imaging (NMR) indicates that EDA and PC have successfully bonded to the surface of phytoglycogen. A library of NP with different degrees of modification were synthesized.Isothermal titration calorimetry will quantify the protein absorption on the surface of the candidate NPs. This will assess their antifouling ability. Creation of an antifouling PhG NP allows the maintenance of assigned functionality in vivo. This expands the biomedical applications of this newly emerging biosourced NP.

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