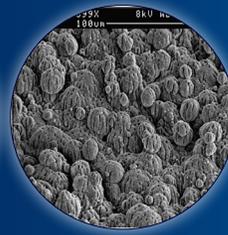
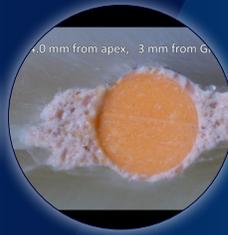
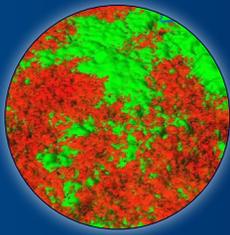




THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Dentistry



Research Day 2022

Vanquishing Foes: The Haapasalo Method

Tuesday, January 25, 2022

ABSTRACTS

1. Partial Recordings to Study Untreated Periodontitis and its Risk Factors

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Objectives: To test the accuracy and precision of estimating the prevalence and associated risk factors of untreated periodontitis using partial-mouth recording protocols (PRPs).

Methods: A purposive sample of 431 individuals who had never been treated for periodontal disease were recruited from screening dental clinics at the King Saud bin Abdulaziz University for Health Sciences. Background questionnaires inquired about demographic characteristics, level of formal education, monthly income, medical conditions, use of medications, dental history, frequency of toothbrushing, use of interdental aids, smoking, perceived stress, and perceived social support. Periodontal examinations were performed by a certified periodontist at six sites per tooth in a maximum of 28 teeth. The prevalence of periodontitis was defined using the case definitions for epidemiological studies recommended by the Center of Disease Control and Prevention and the American Academy of Periodontology. Three PRPs were selected: full-mouth recordings at mesiobuccal and distolingual sites (FM)MB-DL, random half-mouth (RHM), and half mouth at mesiobuccal and distolingual sites (HM)MB-DL. The three PRPs were compared to full-mouth recordings in terms of sensitivity, specificity, predictive values, and absolute bias.

Results: The prevalence of moderate-severe periodontitis and severe periodontitis were 78.4% and 31.3%, respectively. The prevalence of periodontitis was estimated with the highest accuracy and precision with the (FM) MB-DL recordings, followed by RHM. The absolute bias indicated by OR for the risk factors was small for the three PRPs and ranged from -0.8 to 0.8.

Conclusion: (FM) MB-DL and RHM were the PRPs with moderate to high levels of accuracy and precision for estimating the prevalence and risk associations of untreated periodontitis. The study showed that the magnitude and direction of bias were associated with the severity of periodontitis, specific PRPs, and the magnitude of the risk factors.

2. Residents' Autonomy in Surgical Training Programs: a Scoping Review

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Objectives: The ultimate aim of postgraduate health science programs that involve surgical training is to graduate competent independent practitioners. The attending supervisors need to balance between supervision and residents' autonomy to accommodate their responsibilities toward their patients and trainees. The objective of this scoping review was to identify, examine, and synthesize the sources of evidence on clinical attendings' perspectives and attitudes toward trainees' autonomy in postgraduate health science programs that involve surgical training.

Methods: This scoping review was conducted based on the Joanna Briggs Institute (JBI) methodology of scoping reviews. The guiding search question was set as "How is trainees' autonomy perceived by surgical educators in postgraduate health science programs?". The following electronic databases were searched: MEDLINE via Ovid, EMBASE via Ovid, CINHALL, and Eric through EBSCO Host. The search also included grey literature, hand-searching of journals in health science education, and reference lists of the included articles.

Results: The search resulted in 2147 articles which underwent title and full-text screening for the inclusion criteria. The scoping review resulted in 35 articles published between 2009 and 2021. The majority of the articles were conducted in the USA (86%). Programs included were mainly general surgery and none were related to dental programs. Twenty-five articles were primary studies, 1 systematic review, 6 narrative reviews, 1 seminar paper, 1 opinion article, and 1 editorial. Literature was organized into four themes: the significance of autonomy in surgical training, the presence of a gap in the perception of autonomy between attendings and residents, offering autonomy as an attribute of successful clinical attending, and the factors that affect the decision of offering autonomy.

Conclusions: Residents' autonomy in surgical training is critical and its complexity is well recognized by educators. The concept of autonomy is under-researched in dental programs that involve surgical training.

3. Peptide-DJK-5 Effect on Oral Biofilms in Primary and Retreatment Settings

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Objectives: This study aimed to evaluate the long-term effect of the antimicrobial DJK-5 peptide on oral biofilm recovery in different nutritional conditions and examine whether biofilms become more resistant after partially surviving initial treatment and having time to fully recover.

Methods: Oral biofilms were grown anaerobically on collagen-coated hydroxyapatite discs for 3 weeks and subjected to the DJK-5 peptide, Chlorhexidine, or sterile water. Brain heart infusion (BHI) broth culture media was changed weekly for half of the samples (refreshed BHI group) and left unchanged for the other half (unrefreshed BHI group). Treatment re-exposure was done after all biofilms had recovered, namely at 16 and 20 weeks after initial exposure. The biofilm volume and proportion of dead and live bacteria in biofilms were assessed immediately after treatment and 1, 2, 3, 5, 8, 12, 16, and 20 weeks after exposure using confocal laser scanning microscopy using a live/dead viability stain. The assessment was also done after 16- and 20-week retreatments.

Results: DJK-5 killed approximately 82% of biofilms. The proportion of viable bacteria returned to pre-treatment level at 16 weeks in the DJK-5 unrefreshed BHI group, while it required 12 weeks for the refreshed BHI group to return to the same level. The overall biovolume reduction for the DJK-5 refreshed BHI group was 48-56%, whereas it was higher for the unrefreshed BHI group (48-65%). During 16- and 20-week retreatments, the DJK-5 effect remained similar to the immediate effect for the refreshed BHI group. However, the impact was higher among the unrefreshed BHI group at 20 weeks (86%).

Conclusions: Biofilm recovery was slower among the unrefreshed BHI groups than refreshed BHI groups, and the recovery time after DJK-5 exposure was the longest. During retreatment, DJK-5 presented a similar or even stronger effect to primary treatment when used to treat biofilms, which lasted longer in harsher nutritional conditions.

4. A Novel Model to Evaluate Fatigue Resistance of NiTi Instruments

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Objectives: The aim of the current study was to develop a model for testing cyclic fatigue resistance of rotary NiTi instruments by comparing cyclic fatigue resistance of TruNatomy (Dentsply Sirona, Ballaigues, Switzerland) instruments undergoing rotational and axial movement, or rotational movement only, taking into consideration the size of the canal and location of the curvature.

Methods: TruNatomy Prime and Medium files were subjected to cyclic fatigue testing in simulated canals using a model with either rotational movement only or rotational and axial movement simultaneously. Prime files were tested in 30/04 and 30/06 sized canals and Medium files were tested in 38/04 and 40/06 sized canals. There were also three different curvatures (coronal, middle, apical) that the files were instrumented in. The simulated canals were immersed in water with the temperature regulated at 37°C +/- 2°C. The number of cycles to failure (NCF) was recorded and the length of the fractured fragments was measured. Unused files were examined by differential scanning calorimetry.

Results: Rotational and axial movement of TruNatomy files led to greater fatigue resistance compared to rotational movement alone ($P < 0.001$). Apical curvatures led to greater fatigue resistance than curvatures in the coronal and middle third ($P < 0.001$). The type of file did not have an influence on fatigue resistance when the influence of all factors on fatigue resistance were included.

Conclusions: Rotational and axial movement of TruNatomy files led to greater fatigue resistance compared to rotational movement alone, indicating that future studies on fatigue resistance should implement a model with rotational and axial movement, as it is more comparable to a clinical scenario. The fatigue resistance of files in the apical third was greater than in the apical and middle thirds. There was no difference in fatigue resistance between Prime and Medium TruNatomy files.

Acknowledgements: Supported by Dentsply Sirona and UBC Faculty of Dentistry

5. Physicochemical Properties of Methacrylate-Based Dental Resins Containing Photosensitive Compounds

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Objectives: Dental caries is a multifactorial chronic disease that results in debilitating complications and financial strain, exacerbated by the common recurrence of this disease after treatment. To overcome the limitations of existing treatment modalities we pursued the development of methacrylate-based dental resin blends containing different photosensitive compounds towards use in an antimicrobial photodynamic therapy-based approach. The main objective of this study was to determine the effect of photosensitive-compound (undisclosed NP and PS) loading on the degree of conversion (DC), water sorption (WS), and solubility (SL) of experimental methacrylate-based resin blends (RBs).

Methods: For NP-added RB (NP-RBs), nine formulations were produced with 50–150 nm NP at 1 to 40 wt%. For PS-added RB (PS-RBs), eight formulations with PS at 0.10 to 10 wt% were produced. Blends were analyzed by FTIR for DC after 30 or 60 s curing time (n=3). A 7-day WS/SL analysis in 37°C MQ H₂O was then conducted on disks made from select formulations (n=6). Data were subjected to a univariate general linear model and post-hoc Tukey test ($\alpha=0.05$).

Results: A detectable decrease in DC was identified for concentrations above 25% NP and 10% PS when compared to that of the 0% blends ($p<0.001$ for both). For NP formulations, adding 5% and 20% NPs had a detectably greater WS ($p=0.02$) and SL ($p=0.010$) compared to the 0% blend, respectively. Meanwhile, for PS formulations adding 1.0 and 1.5% detectably decreased the WS and SL from that of the 0% blend ($p<0.001$).

Conclusions: The DC of blends containing up to 20% NP and 5% PS were comparable to that of the unloaded blends. Meanwhile, a desired decrease in WS/SL was noted when PS was added to the formulations. This study confirmed for the first time the feasibility of adding different photosensitive compounds to methacrylate-based dental resins.

Acknowledgements: Supported by the New Frontier in Research Fund, Government of Canada, (NFRFE-2019-00061); the UBC Dental Biomaterials Undergraduate Summer Research Award; and UBC Faculty of Dentistry Start-up funds.

6. Special Olympics BC's Virtual Oral Health Self-Assessment Tool: Pilot Study

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Objectives: Due to SARS-CoV-2 (COVID-19), the in-person Special Olympics BC (SOBC) Special Smiles program for athletes' oral health assessments and education was adapted to a 75-minute Virtual Special Smiles Self-Assessment Program (VSSSAP). This survey study aimed to determine if the VSSSAP supports athletes in self-identifying unmet dental needs and assess oral health professionals' (OHPs) attitudes and intended behaviours.

Methods: Prior to the VSSAP, athletes and OHPs, including dental/hygiene students, were asked to consent to an ethics-approved UBC pre/post surveys adapted from the iADH toolbox. OHPs pre/post surveys measured attitudes and intended behaviours, and SOBC athletes' post-survey measured satisfaction, ease of use, communication effectiveness, and usefulness of the VSSSAP. The VSSSAP, consisting of 29 oral-health-related polling questions and facts, explored three main domains: 1) demographics and dental history; 2) level of cavities, periodontal diseases, or trauma; and 3) dental urgency. The power sample calculation in reaching data saturation is 36 and 28 for athletes and OHPs, respectively. Descriptive statistics was used to analyze the data.

Results: Currently, 25 SOBC athletes and 15 OHPs attended the VSSSAP. Nine (36.0%) athletes and 7 (46.7%) OHPs completed the UBC surveys; 88.9% of athletes found they could effectively express their dental concerns, 55.6% strongly agreed the VSSSAP met their dental needs, and 66.7% strongly agreed they learned something new. From the pre-surveys, OHPs valued having desirable outcomes when providing virtual care (18.9 + 1.68) and believed peers and colleagues had little influence on this decision (-0.29 +14.5). Post-surveys revealed 66.7% felt CDs could communicate effectively and 33.3% agreed athletes could understand as well as in-person.

Conclusions: Results indicate the VSSSAP supports SOBC athletes in self-identifying unmet dental needs, and OHPs hold positive beliefs and attitudes in their role as supporting members.

Acknowledgements: The study is being conducted in partnership with SOBC.

7. Antimicrobial Properties of Dental Resin Tuned by Adding Natural Compound

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Objectives: Dental caries is one of the most common and costly chronic diseases worldwide. To address the lack of highly effective and long-lasting management strategies we developed natural-compound-loaded dental-resin-blends toward use in an antimicrobial-photodynamic-therapy (aPDT) approach. The main objective of this study was to observe the impact of natural-compound (NC, undisclosed) inclusion on the antimicrobial properties of a methacrylate-based dental-resin-blend (RB). As this is the first investigation of NC incorporation into a restorative dental material *we hypothesized that its inclusion would improve resin antimicrobial properties upon application of blue light.*

Methods: *Streptococcus mutans* (*S. mutans*) biofilms were first formed on sterile resin disk (0%-RB, 0.05%NC-RB, 0.10%NC-RB) surfaces by incubating the specimens with 5×10^5 CFU for 6h or 24h. The samples were then either illuminated for 60s (830 mW/cm²) or left in the dark. After this treatment the *S.mutans* were collected from one set of disks by sonication, serially diluted and plated onto agar plates. Lastly, colonies were counted after 2d in a 37°C, 5%CO₂ incubator (triplicate runs, n=9). Concurrently, a second set of disks were stained with a live/dead bacterial viability kit following treatment and imaged with confocal laser scanning microscopy. Data were subjected to a univariate general linear model and post-hoc Tukey ($\alpha=0.05$).

Results: NC concentration, application of light, and biofilm growth time each detectably impacted colony count ($p<0.001$). These results were further supported by confocal images where it was observed that inclusion of NC and the application of 60s of blue light resulted in a higher number of dead cells.

Conclusions: This study confirms the potential of a NC-loaded methacrylate-based dental-resin to help manage *S.mutans* biofilms in an aPDT-based approach. The inclusion of NC notably improved the antimicrobial properties of the resin following application of blue light. Future studies will seek to optimize the response of this material system to light.

Acknowledgements: New Frontiers Research Funds Exploration (NFRFE-2019-00061) and UBC Faculty of Dentistry Start-up funds.

8. British Columbian Dentists' Perceptions & Practices on HPV Vaccinations

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Objectives: The purpose of this study was three-fold: to investigate whether BC dentists believe administering the Gardasil® vaccine falls within their scope of practice, to determine their willingness to administer this vaccine, and to explore their perceptions and practices in discussing HPV in dental settings.

Methods: A 14-item questionnaire-based survey was developed, piloted, and disseminated in April 2021 to all practicing dentists in British Columbia (3800 registered members at the time) via a bi-monthly email update. The survey included demographics, scope of practice, barriers to discussing the HPV vaccine, willingness to engage in HPV vaccine practices, and willingness to collaborate with primary care providers in HPV vaccine practices. A minimum sample size was set at 200, and SPSS® version 27 was used for descriptive and inferential statistical analyses.

Results: A total of 201 fully completed responses were gathered from across British Columbia (113 were males). Irrespective of age or gender, respondents were willing to educate (87.6%) and refer patients to receive HPV vaccines (91.5%), but less likely to administer the vaccine themselves (53.7%). In combination with the perception that vaccinations fall outside the scope of practice, other barriers included a lack of professional policies and guidelines pertaining to recommendation of the HPV vaccine within the dental setting. In addition, 41.3% of the respondents agreed that they do not feel comfortable discussing sexual history in a dental setting, with clinicians under the age of 30 being the most comfortable in discussing these topics, while those older than 71 years were the least comfortable.

Conclusions: Respondents are unwilling to administer the HPV vaccine within a dental setting, as they perceive the act to fall outside their scope of practice. Despite willingness to discuss and refer patients for HPV vaccination, there remains a reluctance to engage in inoculation efforts within a dental setting.

9. MDP-Mediated Adherence to Rapid-Fired Zirconia - a Fracture Mechanics Approach

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Objectives: The success of all-ceramic restorations depends on strong and stable bonds to dental hard tissues, achievable by adhesive cementation. For zirconia-based restorations, 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) is a suitable primer. Adherence to zirconia imparted by 10-MDP has been investigated with shear and micro-tensile bond strength tests. This study aimed to apply fracture mechanics methodology to investigate the effect of 10-MDP on the adherence of a resin composite luting agent (RCLA) to recently introduced rapid-fired zirconia (RFZ).

Methods: Interfacial fracture toughness (IK_{IC}) was determined with the notchless triangular (NTP) specimen K_{IC} test. Ninety-six NTP specimens were cut and ground from RFZ (Katana) blocks, followed by rapid firing. The samples were then cut into halves and allocated to three groups, each with a different surface preparation protocol prior to bonding: Control, no treatment; MDP, 10 % 10-MDP ethanol primer; and Silane, Bisco Bis-Silane. All samples were bonded with a resin composite luting agent (RCLA; 3M RelyX Veneer Cement) and stored in water at 37 °C. The IK_{IC} was determined after 24 h and 90 d storage. The results were analyzed using an independent samples t-test ($\alpha = 0.05$). Scanning electron microscopy fractographic analysis was performed on representative fractured samples from each group.

Results: At 24 h, the only group that could be tested was the MDP group [$IK_{IC} = (1.3 \pm 0.4)$ $MPa \cdot m^{1/2}$]; samples from the other two groups debonded before testing. For the MDP group, crack propagation occurred cohesively through the RCLA. After 90 d storage, the IK_{IC} of the MDP group dropped significantly, to (0.88 ± 0.3) $MPa \cdot m^{1/2}$.

Conclusions: The fracture mechanics analysis confirmed the suitability of MDP as a primer for RFZ and identified a significant decrease in IK_{IC} upon storage.

Acknowledgements: We would like to thank Kuraray Inc. for the Katana blocks and Rotsaert Laboratory Inc. (Hamilton, Ontario, CA) for firing the samples.

10. Defining Earliest Facial Differences Leading to Cleft Lip in Mice

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Objectives: The risk of developing non-syndromic cleft lip with or without cleft palate is increased by inheriting certain gene variants combined with environmental exposures. Recent data suggests that unaffected relatives have facial and jaw differences compared to control unaffected populations. This suggests that individuals born with clefts were less able to buffer embryonic stresses compared to unaffected relatives. Our objective was to examine the earliest stages of facial morphogenesis to determine whether there are signs of developmental delay or right-left asymmetry in normal or cleft lip-labile mouse embryos.

Methods: We revisited data from Wang et al., 1995 (PMID: 8642057) which included histological sections of five strains of mouse embryos between 13 and 16 tail somites (ts, stages when lip fusion is initiating). We calculated fluctuating asymmetry $L-R/[(L+R)/2]$ and averages between R and L sides for the following measurements: total primary palate area, epithelial area, mesenchymal area, maxillary prominence depth, and primary palate depth. Two-way ANOVA and Tukey's post-hoc tests were performed (Graphpad Prism v9.2.0.332).

Results: Balb/C and C57BL/6J (controls) and three cleft lip-labile strains were analyzed between 13 and 16ts, prior to overt clefts (A/J, A/WySn, and CL/Fr; clefting frequencies of 4, 23, and 24%). There was a significant delay in formation of the mesenchymal bridge between the medial nasal and maxillary prominence between 13 and 16ts (C57 vs. CL/Fr or A/WySn; $p < 0.0001$). Fluctuating asymmetry was greatest between C57 and CL/Fr in epithelial contact size ($p < 0.05$). Variation was mostly explained by strain differences rather than embryo age.

Conclusions: We found that a certain level of developmental instability (R-L asymmetry) is a feature of normal embryo development, but this combined with delays in mesenchymal bridge formation predicts the development of unilateral cleft lip. Populations with increased risk of developing cleft lip may also have increased developmental instability during facial morphogenesis.

11. Cranioskeletal and Dental Abnormalities Following Gestational CSF1R Inhibition in Mice

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Objectives: Colony stimulating factor 1 (CSF1) and its receptor, CSF1R, are expressed in the ectomesenchymal tissues surrounding developing mouse incisors and molars. CSF1R inhibition in utero results in erupted teeth with multiple dental defects. Here, we characterized these morphological dental defects, as well as changes in cranioskeletal morphology, using micro-computed tomography (microCT) scans. We also explored whether altered proliferation in the enamel organ is a likely mechanism for abnormal odontogenesis.

Methods: Pregnant CD1 mice were exposed to PLX5622 via diet, from embryonic day 3.5 (E3.5) – E18. Following this, post-natal day 21 (P21) mice were collected and their heads were microCT scanned. 3D Slicer was used to segment teeth using manual and semi-automated segmentation tools. Geometric morphometric analyses using previously landmarked coordinates was performed using Morpho packages in R. In addition, E18 heads were formalin-fixed, paraffin-embedded, and sectioned for immunofluorescence (IF) of proliferation markers Ki67, phosphor-histone 3, and pCNA. Imaging was performed using a slide scanner and visualized using Case Viewer.

Results: In utero CSF1R inhibition resulted in morphological dental defects including notching and ectopic enamel ridges on incisors, twinning of the maxillary incisors, and taurodontic roots on mandibular first molars. Skulls were wider transversely, shorter in the premaxillary region, and had a significant domed appearance of the posterior cranial vault, while the mandibles were shorter in the anterior-posterior and vertical dimensions (MANOVA $p < 0.01$). IF staining at E18 indicated that PLX5622 treatment resulted in fewer proliferative cells at the cervical loop regions, compared to controls.

Conclusions: In utero inhibition of CSF1R activity significantly impacts the shape of the developing teeth and craniofacial skeleton, suggesting a role for this receptor and osteoclasts in craniofacial and dental ontogeny. A potential mechanism for the observed dental defects may be through altered proliferative activity in the cervical loop regions of the enamel organ.

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12. Sessional Clinical Instructors' Knowledge of Minimal Intervention Dentistry Principles

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Objectives: The purpose of this study was to understand sessional clinical instructors' knowledge of the principles of minimal intervention dentistry in the management of carious lesions.

Methods: A qualitative exploratory approach of inquiry was utilized, and purposeful selection identified sessional instructors for semi-structured interviews. The interview guide presented three clinical caries management scenarios with questions exploring knowledge of five domains: knowledge base, risk assessment, diagnosis, synthesis, and choice of surgical/non-surgical therapy. Thematic analysis of interviews was conducted with an interpretive inductive approach.

Results: Nine interviews were completed. The participants consisted of 6 males and 3 females between 55-76 years of age, with 32-45 years of private practice experience, and who had taught between 3-19 years. One theme that emerged was "foundational knowledge" and the following categories emerged: caries detection methods, caries detection limitations, evaluating lesion activity, categorizing caries risk, and selective versus complete dentin removal. The second theme that emerged was "clinical decision making for non-cavitated and cavitated lesions" and the following categories were identified as influencing the decision to manage a lesion conservatively: adherence to oral health measures, diagnostic uncertainty and assessment of cavitation, pulpal diagnosis, patient cooperation, and economics.

Conclusions: Participants demonstrated consistent levels of foundational knowledge related to caries detection strategies and determining lesion activity. Variation among individuals presented related to synthesis of patient risk factors and subsequent categorization of a patient's caries risk level. Diagnostic certainty influenced whether the participant opted to manage a carious lesion conservatively. As dental schools depend upon community dentists to support clinical educational programs, it would be advisable to consider providing continuing education for sessional instructors to promote the teaching of consistent caries management strategies in the dental educational setting.

13. Quantitative Nuclear Phenotype of Biopsy Samples Predicts Oral Cancer Outcome

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Objectives: Oral squamous cell carcinoma (OSCC) has a survival rate of <50%, largely due to limited methods in early detection and prediction of nodal disease progression. Histology of cancer cells shows distinct nuclear morphology, DNA amount, and chromatin organization. The objective of this study was to determine whether cells from oral cancer biopsy samples can capture these changes and predict clinical outcomes of nodal disease.

Methods: Biopsy samples from 17 OSCC patients (12 LN+, 5 LN-) were stained with hematoxylin and eosin (H&E) for histology and Feulgen-thionin (FT) for nuclei. Regions of interest (ROI) showing SCC were identified on H&E samples. Corresponding areas on the FT sections were segmented and cells were extracted. Using random forest modeling, each cell was analyzed for 93 features that characterized nuclear morphology, DNA content, and chromatin texture, collectively known as the quantitative nuclear phenotype (QNP). A nodal risk score (NRS) ranging from 0 to 1 was given to each cell, with 0 being LN0 and 1 being LN+. A cutoff score yielding the highest sensitivity and specificity was determined and used to assess its predictive value on test samples.

Results: Forty ROIs and 28704 nuclei for grade 1 (well-differentiated) and 2 (moderately-differentiated) tumors were analyzed. A NRS cutoff of 0.33 yielded the highest sensitivity and specificity, and was used to classify nuclei into positive and negative cells. Using 11 training patients, we determined that having >54% of positive cells gives an accurate nodal disease prediction with 100% sensitivity and specificity for the five test patients. One poorly-differentiated patient was also predicted LN+ with 93.2% positive cells. We are aware of the small sample size and more analysis will be performed.

Conclusions: Based on preliminary data, QNP of biopsy samples may give a prediction of nodal disease. This technique may assist in determining OSCC clinical outcomes.

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14. UBC Dental Students' Perspective of Online Learning During COVID-19 Pandemic

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Objectives: The main goal of the study was to understand the impact of the COVID-19 pandemic on DMD students at UBC. In particular, we investigated the limitations, barriers, and facilitators of online learning from students' perspectives, highlighting the issues UBC dental students faced during the 2020-2021 academic year, as well as recognizing some possible contributors to the challenges regarding student engagement in online learning. We hypothesized students' positive engagement outcomes on the preference of distance learning as a new learning strategy that was implemented during the COVID-19 pandemic.

Methods: A literature analysis was performed, with *Moore's Triangular Learning Model* identified as the theoretical framework for use in the study. Furthermore, based on literature findings, a survey with nine questions was created and electronically distributed to UBC DMD students to understand levels of engagement in current online courses based on existing pedagogical strategies. All statistical analysis was completed using SPSS. The data was determined to be non-parametric using the Kolmogorov-Smirnov test. Consequently, a Kruskal Wallis analysis was performed and the confidence interval was set at 95%. The responses to two open-ended questions were analyzed using a thematic analysis technique.

Results: The quantitative results showed there is a statistically significance difference ($p < 0.05$) between senior and junior DMD students with respect to learner-learner, learner-instructor, and learner to content framework in terms of convenience and accessibility when using electronic learning compared to in class learning. The qualitative results showed behavioural and emotional engagement is based on learner-learner and learner-instructor interaction. Cognitive engagement was found in the area of learner-content.

Conclusions: This study found that the overall self-perceived engagement level was promising and UBC DMD students appreciated the online system. The qualitative part of the study revealed concerns regarding potential barriers with respect to structure of the DMD curriculum when transferred to the online environment.

15. The Role of Cytoskeleton Regulators in Embryonic Facial Morphogenesis

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Objectives: Growth factor signaling controls spatial and temporal features of development. However, we know relatively little about the intracellular mediators that control the intensity of signaling. Small GTPases and ROCK are downstream of the non-canonical WNT JNK-PCP pathway. The Rho, Rac, and CDC42 GTPases regulate cell shape, orientation, and migration through regulation of the actomyosin cytoskeleton. Furthermore, components of this pathway were linked to non-syndromic cleft lip with or without cleft palate (NSCL/P). Our objective was to test whether small GTPase signaling is required and sufficient for facial morphogenesis at stages where lip fusion is occurring.

Methods: Faces of E4.5 chicken embryos were dissected to include the frontonasal and maxillary process and placed in organ cultures. Antagonists of small GTPases (ROCK inhibitor 20 μ M, RAC1 antagonist 35 μ M & 70 μ M) or an agonist of RhoGTPases (1 μ g/ml) were used. Organ cultures were fixed and photographed at 0 and 24 h. Percentage growth differences were calculated using ImageJ and analyzed using Prism Graphpad software (v. 9.2).

Results: Control cultures decreased in width over 24 h. The RAC1i did not prevent narrowing of the frontonasal mass; however, ROCKi-treated cultures stayed the same width as at time 0. The RAC1 agonist caused significant decreases in FNM width compared to controls. The height of the frontonasal mass, measured at the nasal slits, normally increases over 24 h. The RAC1 antagonist blocked this growth as did the agonist. Overall, the GTPase agonist caused the frontonasal mass to decrease in size in the X and Y axes.

Conclusions. Changes in facial morphogenesis following activation or inhibition of small GTPases and ROCK may be explained by the direct influence on the cytoskeleton rearrangement resulting in abnormal cell shape and migration patterns. Furthermore, our data suggest that small GTPases act in a complementary way to ROCK during facial development and both are vital for midfacial development.

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16. A Novel Approach for Oral Cancer Screening Using Cellular Morphology

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Objectives: The Health Canada-approved DNA-image cytometry system, ClearCyte, presents a promising non-invasive approach for oral cancer screening, with sensitivity and specificity of 100% and 87%, respectively. However, the reliability of utilizing DNA-content is obscured by batch staining effects, i.e., photometric variables—an inherent source of variability due to staining intensities. Assessing morphological characteristics, i.e., morphometric variables, offers another promising avenue. Here, we explore if cellular morphology alone provides a more robust screening approach.

Methods: This is a retrospective case-control study. A total of 171 oral brushings were included: 69 abnormal samples [histopathology-confirmed oral cancer (N = 46) and carcinoma in situ/severe dysplasia (N = 23)], and 102 controls [reactive lesions (N = 52) and normal samples (N = 50)]. These samples were scanned using ClearCyte and randomized into training and test sets (70:30). Of the total 114 nuclear features (8 photometric and 106 morphometric), two sets of random forest (RF) classification models (with or without photometric variables) were created to calculate the optimal probability that we would identify abnormal cells. Receiver operating characteristic curves were created to calculate the optimal proportion of abnormal cells, i.e., the cutoffs, that identifies abnormal diagnosis with the highest sensitivity.

Results: In the training set, applying all nuclear features and a cutoff of 5.8% abnormal cells, a sensitivity of 100% and specificity of 89% was reached, while applying morphometric variables only and a cutoff of 6.6% abnormal cells provides the same sensitivity and specificity. Using these cutoffs, the test set showed 95% sensitivity using all nuclear features, and 100% using morphometric variables alone.

Conclusions: Use of the morphometric variable alone shows comparable results to those including photometric variables. This non-invasive brushing test provides a promising approach in screening for high-grade oral lesions. Further investigations to validate the test on different sets of samples are underway.

17. A Community Action Report from the Downtown Eastside of Vancouver

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Objectives: To offer a critical reflection on an impoverished neighbourhood in Vancouver, Canada, and the population's access to oral health care.

Methods: A review of how a lack of publicly funded oral health care affects the most vulnerable, uninsured, and underserved citizens was performed. Personal and professional accounts of how entrepreneurial innovations at not-for-profit organizations can help close the gap in access to oral health care is offered using the Vancouver Area Network of Drug Users (VANDU) and the PHS Community Services Society as case studies in British Columbia.

Results: Historically, oral health care has not been part of the Canadian Health Care System, impacting the most vulnerable. Oral health has been an integral part of activism for VANDU members who have lost family members and loved ones to chronic illnesses linked to lack of access to oral health care. In addition, many VANDU members have raised concerns about the stigma and discrimination they face when attempting to access much needed oral health care, and a lack of knowledge from oral care professionals when interacting with VANDU members. To begin to address some of the many issues described, the PHS Community Services Society established a not-for-profit-dental clinic in 2001. The community clinic serves more than 1400 patients annually, for whom oral health has typically been neglected. What is more unique is the commitment to provide oral care in a very patient and thoughtful manner to a population that is often very unfamiliar with dentistry and oral health.

Conclusions: Despite the efforts put forward by not-for-profit organizations such as the VANDU and PHS Community Services Society, a national oral health care plan is warranted though still not a political imperative. Canadians have a right to oral health care that is compassionate and collaborative.

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18. Faculty of Dentistry Students' Perceptions and Behaviours toward Surgical Telescopes

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Objectives: Recent changes to the Faculty of Dentistry's (FOD) undergraduate surgical telescopes and ergonomics curricula required evaluation. This project aimed to better understand students' views and preferences for surgical telescopes, perceptions of educational preparedness to support their informed decision making, and satisfaction levels with their selected equipment. Research question: What are students' perceptions and behaviours toward surgical telescopes in the undergraduate curricula?

Methods: Students in the Doctor of Dental Medicine (DMD) class of 2024 and Dental Hygiene Degree Program (DHDP) class of 2023 completed an online survey through the UBC Qualtrics platform. Multiple choice and Likert scale questions inquired about students' surgical telescope preferences, experiences in the related curriculum, and satisfaction levels with their equipment selection. Open-ended questions solicited suggestions for future curriculum changes.

Results: Forty-eight (48) students from both undergraduate programs responded to the survey for a 56% response rate (DMD: 32/59, 54%; DHDP: 16/26, 62%). Approximately 58% selected fully-adjustable flip-up telescopes with 100% of DHDP students selecting fully-adjustable flip-ups. Approximately 40% of student respondents selected through-the-lens (TTL) telescopes. A majority (79%) selected loupes from SurgiTel, Orascope, or Q-Optics, with 54% of students using 2.5x magnification as recommended by faculty. Almost all (96%) student respondents frequently or almost always used their loupes in the clinical setting, and 75% were satisfied with their choice of telescopes. Approximately half (56%) felt educationally prepared to make an informed decision about selecting their equipment; 23% of student respondents disagreed or strongly disagreed with feeling educationally prepared. An additional clinic session to support their equipment ordering was a common suggestion.

Conclusions: Students reported high levels of satisfaction and frequency of use with their surgical telescopes. However, further curriculum revisions are needed to better support students in their equipment selection process.

19. Barriers to Furthering Education Among Canadian Dental Hygienists: Pilot Study

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Objectives: Canada has seen a growing movement towards development of new pathways to further dental hygienists' education, to strengthen cognitive/practice outcomes, and increase career pathways. According to the 2019 Canadian Dental Hygienists' Association (CDHA) Job Market and Employment Survey, only 18% of respondents hold a bachelor's degree. This study investigated barriers to pursuing further education among Canadian diploma-holding dental hygienists. Research question: what are the barriers, if any, to pursuing further education amongst Canadian dental hygienists holding a diploma as their highest educational credential?

Methods: Purposeful maximum variation sampling was used to select Canadian dental hygienists across 10 provinces and one territory for three focus groups (n=17) conducted through video conferencing. Selected participants were CDHA members who practised with a dental hygiene diploma as their highest educational credential. The e-focus group discussions were transcribed verbatim and underwent thematic analysis for barriers to further education using Saldaña's (2013) approach to descriptive and *in-vivo* coding. Member-checking was completed in two phases: transcripts were provided to participants, followed by thematic summaries to confirm emerging themes. Ethics approval was granted by the University of British Columbia's Behavioural Research Ethics Board (H20-00455).

Results: Barriers included: family obligations, accessibility, perceptions of eligibility, lack of employer support, and financial restrictions. Other prevalent themes were awareness of programs offered and the benefits of completing a degree. Participants also raised concerns around the stress and anxiety of being in school.

Conclusions: These focus group findings were used to supplement answer options for a national online survey distributed to all CDHA members. Survey results will then inform CDHA, provincial associations, and educational institutions of barriers to pursuing further education, strategies to reduce those barriers, and facilitate the furthering of degree education for Canadian dental hygienists.

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20. Clinical Features of Lichenoid Mucositis with Dysplasia: Differences between Subtypes

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Objectives: Oral epithelial dysplasia (OED) is regarded as an Oral Potentially Malignant Disorder (OPMD). While an inflammatory reaction is a common feature of OED, it is difficult to differentiate histologically whether the dysplasia seen in oral lichenoid mucositis (LM) is reactive in nature (low malignant risk) or indicative of true malignant risk. We hypothesized that LM with mild or moderate (low grade) dysplasia (LGD) that progressed to severe dysplasia, carcinoma in situ (high grade dysplasia (HGD), or squamous cell carcinoma (SCC) will have a higher proportion of clinical features of dysplasia, and a lower proportion of clinical features of LM (bilateral and/or reticular clinical presentations), compared to not progressing LM with LGD.

Methods: Clinical data collected from patients with biopsy-confirmed LM with dysplasia were collated and analyzed. Images of the lesions were reviewed to confirm the clinical data. Statistical analysis was performed to compare clinical features between the progressors (LM with LGD that progressed to HGD or SCC) and non-progressors (LM with LGD that did not progress to HGD or SCC). Subjects were enrolled in the Oral Cancer Prevention Longitudinal Study.

Results: Progressors showed a significantly higher proportion of high-risk clinical characteristics (non-homogenous appearance and erosive or verrucous texture) ($P < 0.05$). Progressors showed more changes in clinical presentation such as size, texture, and appearance over time than non-progressors ($P = 0.002$). Bilateral and/or reticular clinical presentations were more common in the non-progressor group ($P = 0.003$).

Conclusions: LM with LGD without reticular or bilateral lesion presentation has an increased risk of progression to HGD or SCC and should be followed closely.

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21. The Key Contributors to Professional Identity Development in Dental Education

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Objectives: Professionalism is defined as “the conduct, aims, or qualities that mark a profession or a professional person.” In dental education, an educator’s ultimate aim is to prepare students to become competent clinicians who exhibit professionalism. One recent scholarly attempt in defining and obtaining professionalism is to help students develop a professional identity. This study aimed (1) to investigate and analyze the relevant components of professional identity in dental students, and (2) to explore students’ concerns toward their professional identity development.

Methods: This qualitative study comprised interviews from 18 students who voluntarily participated in hour-long individual interviews. The study participants were from the first DMD cohort after its severance from the Faculty of Medicine at the University of British Columbia. After obtaining the audio files, they were transcribed and corrected by a research assistant to ensure the accuracy of the transcriptions. Using QSR International’s NVivo (Version 12) software, the researchers of this study then conducted a thematic analysis of relevant sections of the transcripts to generate overarching themes and extracted the relevant components pertaining to professional identity formation from the identified themes.

Results: From the overarching themes, self-efficacy from practical and technical skills, role modelling and mentoring, professional socialization, and reflection were extracted as the key contributors to professional identity development. For educators, improved role modelling and the clinical milieu were found to be critical in terms of helping students form their professional identity.

Conclusions: Understanding the main concerns for students and improving the learning environment is critical in helping students form their professional identity. The findings of this qualitative study identified some important aspects of the dental curricula for educators to consider. These results can be used by future research studies to explore models for professional identity assessment tools that can aid in guiding students’ professional identity development.

22. Dentin Bond Stability of Next-Generation Dental Adhesive Resins

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Objectives: One of the main causes of oral diseases such as dental caries and periodontitis is the presence of pathogenic biofilms. Combined with a high-sugar diet and poor oral hygiene, cariogenic biofilms can lead to primary and recurrent caries lesions, which is a main cause of restoration failure. Next-generation restorative materials should exhibit mechanical stability and long-lasting antimicrobial properties to improve the durability of dental restorations. Our objective was to evaluate the shear bond strength (SBS) to dentin of experimental resin blends (RB) loaded with photosensitive agents, either metallic nanoparticles (NPs) or a natural compound (PS), as a function of photosensitive agent concentration and ageing time in water.

Methods: Extracted human teeth (REB-H14_02189) were sectioned coronally and polished with 800-grit SiC paper to expose the dentin surface. Experimental groups included: commercial control ScotchBond™ Universal Adhesive (SBMP), RB with metallic NPs (0%, 5%, 10%, 20%), and RB with the natural compound (0%, 0.1%, 1%, 1.5%). Experimental RBs were applied as a three-step etch-and-rinse system, and subsequent composite build-up (Ultradent jig) was placed on each dentin surface. Light curing was performed using a Valo light-curing unit (Ultradent) at 800 mW/cm². Samples were stored at 37°C for 24 h or 28 d, and tested for SBS at 0.5 mm/min (Bisco Shear Tester, Bisco Inc.). Data were subjected to univariate general linear model and post-hoc Tukey analysis ($\alpha=0.05$).

Results: Different concentrations of the photosensitizing agents, NPs ($p=0.340$) and PS ($p=0.367$), did not significantly affect SBS to dentin. SBS of experimental adhesives was also similar to SBMP. However, similar to SBMP, aging resulted in a detectable decrease in SBS ($p<0.001$ for both agents).

Conclusions: Experimental resin blends showed similar SBS as the commercially available adhesive resin in immediate and aged samples. Initial statistical modelling showed that aging had a detectable impact on both experimental blends and the commercial control.

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23. Pediatric Dentists' Recommendations and Knowledge of Teething Management Strategies

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Objectives: The aim of the study was to investigate pediatric dentists' recommendations and knowledge of commercially available teething products, as well as home remedies intended to manage the signs and symptoms associated with teething.

Methods: An online, 29 item cross-sectional census survey was sent via Qualtrics Software (Qualtrics, Provo, UT) to 315 certified pediatric dentists with email addresses and registered across Canada.

Results: The response rate was 28%. The most commonly recommended teething strategies were pressure (40%) via teething toys (20%) and massaging/compressing the gingiva (20%), followed by cold (26%) and systemic analgesics (23%). The majority of pediatric dentists knew that localized irritation of gingiva (18%), generalized irritability (17%), and increased drooling (18%) were associated with teething. The majority of pediatric dentists (86%) were also not able to describe the mechanism of action of any ingredients in homeopathic products. Less than half (48%) of pediatric dentists thought homeopathic products were not useful. When asked to recommend alternative teething management after parents have tried using cold compresses and pressure from teething toys, the majority of pediatric dentists (63%) would then recommend systemic analgesics.

Conclusions: The results suggest that most pediatric dentists initially recommend low to no-cost simple remedies such as pressure and cold to manage symptoms associated with teething. However, more education is needed among pediatric dentists about the regulation and mechanism of action for both commercially available teething products as well as home remedies to decrease the potential for adverse outcomes among teething infants.

24. Fit Assessment of Digital RPDs Using Digital and Conventional Replicas

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Objectives: There are several methods to assess the fit of removable partial dentures (RPDs), including replica and triple scanning techniques. The replica technique is limited by measurement errors, while the triple scan technique is associated with superimposition errors. Therefore, further research is needed to refine the superimposition process and produce accurate digital measurements. The digital replica method is expected to overcome triple scan over-integration issues. In this study, a digital replica method was developed and compared to the conventional replica method to assess its accuracy and effectiveness in measuring the fit of selective laser-melted RPDs.

Methods: A mandibular Kennedy class II mod 2 resin model with five pyramid reference points was created. Twelve frameworks were digitally designed and fabricated. The gap between the frameworks and the model was captured using silicone impression material, then digitally scanned and evaluated using Geomagic software at five pyramids, rest seats, and guiding planes. The thickness of the impression material was then measured at the five pyramids via the conventional method with a caliper to validate the digital measurements. T-tests were used to statistically analyze the difference between groups ($p < 0.05$).

Results: Digital and conventional replica measurements at pyramid reference points were not significantly different ($p > 0.05$). The mean gap measured at all five pyramids was $90 \pm 46 \mu\text{m}$ via the digital method and $86 \pm 28 \mu\text{m}$ via the conventional method ($p = 0.59$). Digital measurements of rest seats were $91 \pm 51 \mu\text{m}$ and guide planes were $117 \pm 60 \mu\text{m}$.

Conclusions: The digital replica method produces positive values, overcoming over-integration issues faced in the triple scan technique. It also enables more accurate evaluation of the functional units of RPDs, such as rest seats and guide planes, which are difficult to measure using the conventional method. Both digital and conventional replica methods are reliable in determining clinically acceptable fit.

25. Exploring Photocatalytic Metallic Nanoparticles Loaded in a Resin-based Dental Biomaterial

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Objectives: Dental caries is one of the most common chronic human diseases; however, not much has been accomplished with current resin-based dental materials to improve their antimicrobial properties. The inclusion of metallic nanoparticles (NPs) in resin blends (RB), with their previously confirmed anti-microbial and photocatalytic properties, is a promising new approach to better manage this disease. The objective of this study was to evaluate the antimicrobial and flexural strength (FS) of a RB loaded with metallic NPs with photocatalytic capacity in response to blue light. It was hypothesized that the loading of metallic NPs will improve antibacterial properties of the RB without impacting its FS.

Methods: Metallic NPs (at 0 to 20 wt%) were added to an experimental RB. Light-cured 25 mm-long bars were tested for FS after 24 h (“immediate”) and 28 days (“aged”) in 37°C MQ H₂O (N=12). Next, light-cured 6-mm-diameter disks were seeded with *S.mutans* for 6 h before serially diluting the recovered bacteria and re-plating them for 2 days on blood agar plates and counting (N=3). Data were subject to a two- or one-factor general linear model with post-hoc Tukey analysis (p=0.05).

Results: A significant increase in FS values were observed for all groups after 28-day storage (p<0.001). However, while there was a detected impact of NP concentration on FS (p<0.001), the difference from the 0% RB was not significant. Preliminary antimicrobial results showed a detected decrease from the respective test control (p<0.01) for most sample groups independent of light application. Furthermore, application of light detectably impacted antimicrobial results (p<0.001).

Conclusions: Results indicated a potential benefit of including NPs in a dental resin on the antimicrobial properties. In addition, NP inclusion with 28-day ageing resulted in a significant increase in FS. Future studies will explore surface treatments and/or functionalization of the NPs to enhance bonding with the resinous matrix.

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26. Fracture Toughness of Conventional, Milled, and 3D Printed Denture Bases

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Objectives: To determine the fracture toughness (K_{IC}) of conventional (C) denture base materials using the Notchless Triangular Prism (NTP) specimen K_{IC} test and compare it with that of CAD/CAM (Milled, M) and 3D-printed (P) denture base materials at 7 and 90 days.

Methods: Lucitone 199 (C), Lucitone 199 CAD (M), and Lucitone Digital Print (P) (Dentsply International Inc.) were used to fabricate NTP specimens (40/group). Samples were conditioned according to ISO 20795-1 in 37°C water for 7 (20/group) and 90 days (20/group). Samples were stored in 23°C water for 1 h prior to testing. For testing, samples were secured in custom-made jigs, replicating the chevron-notch short rod specimen configuration. The test assembly was loaded in tension (0.1 mm/min) until crack arrest or failure. The maximum recorded load was used to calculate K_{IC} . Two-way ANOVA, followed by Scheffé multiple mean comparisons ($\alpha = 0.05$), independent t-tests, and Weibull statistics were used to analyze the results.

Results: The analysis of the results have shown that the three tested materials had significantly different K_{IC} at 7 and 90 days, with the same ranking, i.e., $P > C > M$ ($p < 0.005$). The results have also shown that ageing in 37°C water for 90 day resulted in a significant decrease in K_{IC} in the C and M groups ($p < 0.001$).

Conclusions: The printed denture base material exhibited significantly higher K_{IC} , higher absorbed energy before fracture, and stability under ageing conditions, suggesting it could be more resistant to crack propagation than the conventional and milled materials. Milled denture bases showed the least resistance to crack propagation with the lowest K_{IC} values at both 7 and 90 day. Water storage for 90 days significantly decreased the K_{IC} of conventional and milled materials, with no effect on the K_{IC} of the printed denture bases.

27. Wellbeing, Coping, and Resilience in Oral Health Sciences Education

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Objectives: Wellbeing is an important and multifaceted construct that has gradually gathered attention in oral health sciences education literature. Traditionally, research has focused on the prevalence and the sources of mental health conditions (e.g., stress, depression, burnout). To date, little has been done to explore positive psychological outcomes, such as wellbeing, coping, resilience, and adaptation. This scoping review aims to map the available literature on wellness in oral health sciences education, including characteristics of previous studies, conceptualizations, and main findings of relevant studies.

Methods: Online databases (Medline®, PsycInfo, CINAHL, and Embase®) were used to identify peer-reviewed studies published in English, between the years 2000-2021. The last inclusion criterion was the studied phenomena. Papers were included in the review if they studied wellbeing, wellness, or other positive psychological outcomes such as resilience, coping, adaptation, and quality of life (QoL). The population of interest was dental, dental hygiene, and allied dental sciences students.

Results: The initial search produced 2699 papers. Following the de-duplication, title, abstract and full-text screening, the final number of reviewed publications was 68 studies. A total of 19 papers studied the concepts of wellbeing and wellness, while 23 papers addressed coping and adaptation mechanisms. Resilience and QoL were discussed in 13 papers, and 9 papers discussed several positive psychological outcomes, including happiness and grit. The reviewed studies were mostly cross-sectional, with only three interventional studies. Major primary themes included the role that gender identity, ethnic origin, and patient care responsibilities play in students' overall wellbeing.

Conclusions: A growing interest in oral health sciences students' overall wellbeing is evident in the literature. However, the limitations of the cross-sectional design of the reviewed papers call for further longitudinal and interventional studies to understand the changes in students' wellbeing as they progress in their studies, and design interventions to promote their overall wellbeing.

28. Undergraduate Dental Students' Appraisal of a Pandemic Preparedness Model

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Objectives: COVID-19 has significantly impacted oral health care services and preparedness models can better guide oral health care providers during a health crisis such as a pandemic. This study aimed to perform an initial appraisal of the usability, spatial representation, and clarity of a preparedness model for the provision of oral health care during the COVID-19 pandemic from the perspectives of senior undergraduate dental students at the University of British Columbia.

Methods: In 2021 senior undergraduate dental students were asked to critically appraise a newly developed preparedness model via an essay with open-ended queries pertaining to the model use, spatial display, and clarity. The appraisal was part of the dental geriatric module and took place between March and June 2021. Each essay had a 2000 word maximum and the answers were analyzed thematically by a coding process.

Results: Fifty-nine senior students in their 3rd or 4th year appraised the preparedness model, generating more than 100 pages of text. The coding process generated more than 200 codes and led to the identification of four main themes, including “streamlined depiction”, “information-based approach”, “adaptability to an ever-changing situation”, and “room for improvement”. While the majority of the students appraised the model as being useful in fostering information-seeking behaviour, four students suggested alternative portrayals to better reflect their views and understandings about oral health care and the pandemic.

Conclusions: The majority of the senior undergraduate dental students appraised the newly developed preparedness model as helpful, and some suggested an alternative portrayal. A comprehensive assessment of the newly developed model (and of its variations) by practicing oral health care providers and patients is warranted to better support the provision of oral health care services during a pandemic.

Acknowledgements: The authors are grateful to all the students who submitted their thoughtful essays. This study was funded by the 2021 UBC Faculty of Dentistry Summer Student Award competition.

29. Prevalence of Incidental Findings in Lateral Cephalograms of Orthodontic Patients

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Objectives: Lateral Cephalograms (LCs) have been used as part of pretreatment records of orthodontic patients for diagnosing and treatment planning. Since LCs contain many important structures beyond the orofacial complex, accurate examination of these areas is very important even though it may not be a part of orthodontic diagnosis. Incidental findings of clinical significance are believed to be present very commonly on LCs, and thus orthodontists are more likely to encounter those. The purpose of this study was to determine prevalence of incidental findings in LCs taken for orthodontic diagnosis of patients seeking orthodontic treatment at UBC's Graduate Orthodontic Clinic.

Methods: A total of 1765 consecutive patients' pretreatment LCs were inspected retrospectively. The age range was restricted to 12-20 years old at the start of orthodontic treatment. All the LCs were checked using Romexis image capturing software. Each LC was examined in the following three zones systematically: cranium, neck, and cervical spine, and in the dentofacial complex. Additionally, the size of the Sella Turcica was measured in Romexis.

Results: The overall prevalence of incidental findings was 18.8%. Ponticulus Posticus was the most prevalent finding (10.3%), followed by bridging of the Sella Turcica (4.2%). Sella Turcica height ranged from 1.1-12.0 mm and width ranged from 2.6-15.8 mm.

Conclusions: Incidental findings are prevalent on LC radiographs taken for orthodontic diagnosis and treatment planning. Thus, careful examination of LCs beyond the area of orthodontic interest is very important. Males are more likely to present with incidental findings than females. As far as the individual anomaly is concerned, only Occipital Spurs were more likely to be present in males than in females. Ponticulus Posticus and Occipital Spurs were the highest co-occurring incidental findings in the sample. Follow up LCs revealed no additional prevalence of incidental findings.

Acknowledgements: Supported by UBC's Faculty of Dentistry.

30. Exploring Stressors and Coping Among Dental Students During COVID-19 Pandemic

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Objectives: The COVID-19 pandemic has caused stress on undergraduate dental students. While some stress may be protective by preparing students to manage certain challenges, overwhelming stressors can be detrimental to their mental health; coping mechanisms might be employed to deal with stressors. The present study undertook a scoping review to identify and discuss the COVID-19 pandemic related stressors impacting dental students' mental health across the world and a cross-sectional study exploring the coping mechanisms employed by dental students at the University of British Columbia (UBC) during the pandemic.

Methods: The Joanna Briggs Institute's framework for scoping reviews was used to identify systematically peer-reviewed publications reporting mental health issues in dental students from the onset of the COVID-19 pandemic until June 22, 2021. An anonymous survey was distributed among all classes in the UBC undergraduate dental program. The survey asked for de-identified sociodemographic data and posed a semi-structured question about stressors and coping strategies via the Brief-COPE inventory.

Results: Fifty-five publications were included in the scoping review; fear of contagion during patient interaction was reported to be the predominant stressor of dental students, followed by skill deficits. From the 229 eligible students, 182 (79.5%) responded to the survey and 54.4% were stressed about clinical skill deficits due to the pandemic. Emotional support, self-distraction, and positive reframing were the most used coping strategies. Adaptive coping was significantly higher in first, second, and fourth year students compared with third year students ($p < 0.001$, CI 2.45-7.55). Social isolation was a significant predictor for maladaptive coping ($p = 0.001$).

Conclusions: The main cause of stress related to the COVID-19 pandemic for dental students at UBC was their clinical skills being affected. Coping strategies that students frequently use were identified. Continued mitigation efforts should be made to address students' mental health concerns and create a supportive learning environment.

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31. Flexural Strength and Antibacterial Potential of a Photosensitizer-Loaded Dental Resin-Blend

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Objectives: The Global Burden of Diseases has identified caries as the most common health condition; however, no natural approach exists which is readily available and highly effective for dental caries management. To address this need, our objective was to develop a methacrylate-based resin-blend (RB) loaded with a natural photosensitizer (PS) which may be effectively used in an antimicrobial photodynamic therapy (aPDT)-based approach. We hypothesized that the addition of an undisclosed natural PS will improve antimicrobial properties of the RB without negatively affecting its flexural strength (FS).

Methods: 0.1, 1.0, or 1.5 wt% PS was added to a standard resin blend. For FS, 25-mm-long light-cured beams were stored for either 24 h (“immediate”) or 28 days (“aged”) in 37°C Milli-Q water before testing (n=14). Next, for antimicrobial testing, light-cured disks were tested fresh or similarly stored for 28 days. Disks were then incubated with *Streptococcus mutans* (*S. mutans*) for 6 h before serial dilution and counting of colony forming units (CFU) on agar plates (n=3). Data were subjected to a univariate general linear model and post-hoc Tukey tests ($\alpha=0.05$).

Results: Ageing of samples resulted in a noted increase in FS at each PS concentration ($p<0.001$). Meanwhile, the addition of PS had minimal impact on FS, with only immediate 1.5% PS-RB having detectably lower FS than immediate 0% and aged 1.0% PS-RB had lower FS than aged 0% (both $p<0.001$). Lastly, no significant dependence of CFU count on PS concentration, ageing, or application of light was detected (n=3).

Conclusions: Experimental resin blends loaded with natural PS have significant potential to be used in aPDT approaches. While 28-day ageing of the PS-RB notably increased FS, preliminary data shows that antimicrobial potential was not compromised. Future work will optimize responses to application of light and confirm antibacterial results using current conditions.

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32. *Salvia miltiorrhiza*-derived Inhibitor Evaluation Against 3CL Main Protease of SARS-CoV-2

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Objectives: The dimeric SARS-CoV-2 cysteine protease 3CLM^{pro} is a drug target for the development of antiviral therapies. Very recently, an active site-directed inhibitor proved efficacious in a clinical trial to treat COVID-19 patients. Ectosteric inhibitors acting by disrupting protein-protein interactions have not yet been widely studied as 3CLM^{pro} inhibitors. We have previously shown that tanshinones can prevent oligomerization and the activity of other proteases. Therefore, we screened tanshinones as potential 3CLM^{pro} inhibitors in protease assays, by molecular docking, and virus infection assays.

Methods: Recombinant SARS-CoV-2 3CLM^{pro} was expressed in *E. coli* and its activity was determined using a fluorescence-based substrate assay. Thirty-one tanshinones were evaluated for their inhibitory activity and IC_{50} values were determined for the most potent compounds. Molecular docking was used to predict potential binding sites of the most potent compounds, and selected compounds were evaluated in a SARS-CoV-2 cell infection assay.

Results: 3CLM^{pro} was purified using two chromatography steps, and its kinetic substrate hydrolysis parameters were determined (K_m : $4.7 \pm 0.7 \mu\text{M}$ and V_{max} : $0.08 \mu\text{Ms}^{-1}$). Out of 31 tanshinones, T06 and T29 proved the most potent compounds with IC_{50} values of 17.4 ± 3 and $10.8 \pm 0.6 \mu\text{M}$, respectively. Molecular docking predicted distal binding from the active site for these inhibitors in the vicinity of the dimerization site. T06 demonstrated an IC_{50} value of $20 \mu\text{M}$ in the viral infection assay. Other non-3CLM^{pro} inhibiting tanshinones were more potent in this assay, indicating alternative molecular targets in the SARS-CoV-2 proteome.

Conclusions: Tanshinones, a major component of traditional Chinese medicine, have the potential to inhibit 3CLM^{pro} in SARS-CoV-2 and to act as an antiviral in a SARS-CoV-2 infection model. They may provide a platform for future medicinal chemistry efforts for non-active-site directed inhibitors. Future structural analyses of the protease-inhibitor complexes are needed to understand the inhibitor mechanism.

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33. Is Personal Protective Equipment Enough against Covid-19 in Dental Settings?

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Objectives: Several studies have highlighted that the SARS-CoV-2 transmission rate in dental settings remained lower than expected despite the potentially high risk of infection via aerosols and saliva droplets. Many public health bodies and dental and dental hygiene associations encourage compliance with infection prevention and control guidelines, including airflow quality monitoring and the use of Personal Protective Equipment (PPE); many practices seemed to rely solely on PPE, however. This study aimed to critically evaluate the evidence behind the low SARS-CoV-2 transmission in oral healthcare settings considering the suggested guidelines.

Methods: A brief literature search on PubMed was conducted on June 16, 2021, for peer-reviewed publications pertaining to transmission routes of COVID-19 in dental settings, clinical data on infection rates, proposed preventive measures, the effectiveness of protocols, and different practices' levels of compliance with the protocols. Only full-text publications in English were included.

Results: After applying the limits and excluding the duplicates, 152 papers were identified. After eliminating those outside the scope of this review, 77 publications were reviewed, including 36 discussing preventive measures taken in specific dental settings and infection rates among professionals, and 21 studies studying and comparing the clinical effectiveness of specific measures. The evidence suggests the transmission of SARS-CoV-2 in dental settings is extremely low, but only when the measures proposed by the World Health Organization are in place on top of regular PPE, including high-speed suction units and adequate ventilation.

Conclusions: PPE alone might not be enough to fully prevent the transmission of COVID-19 in dental settings. Thus, compliance with airborne infection prevention protocols along with the use of PPE should be the goal. We suggest these new protocols are probably here to stay within the dental profession long after the COVID-19 pandemic is over.

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34. Characterization of Defects in NiTi Retreatment Instruments after Clinical Use

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Objectives: The purpose of this study was to characterize defects in XP Shaper (XPS; FKG Dentaire, La Chaux-de-Fonds, Switzerland) and XP Finisher-R (XPFR; FKG Dentaire) instruments discarded by four endodontic clinics after retreatment and to analyze the impact of clinical use on their metallurgical properties.

Methods: A total of 92 XPS and 20 XPF-R instruments with structural deformities were collected from four endodontic clinics over 20 months and were examined under DOM first at 10x magnification. The types of defects and their relative locations were recorded. The lateral and fractured surfaces of the separated instruments were then examined with SEM. Differential scanning calorimetry was used to investigate the thermal behaviour of unused and fractured files.

Results: Of the 112 examined instruments, 77 (84 %) XPS and 4 (20 %) XPF-R had an area of structural change, while 15 (16 %) XPS and 16 (80 %) XPF-R were fractured. All XPF-R that were deformed but unfractured showed unwinding close to the coronal end of the flute. The location of the fractures in XPS and XPF-R was often close to the coronal end of the flutes or the expanding segments of the files. Most of the XPS fractures were due to torsional failure (67 %), while XPF-R failed predominantly due to cyclic fatigue (81 %). The austenite-finish temperature of XPF-R (40 °C) was higher than that of XPS (35 °C). Both XPS and XPF-R exhibited two-stage phase transformations.

Conclusions: The fracture modes of XPS and XPF-R differed in the files showing deformation after use. Torsional failure was more prevalent in XPS and cyclic fatigue more prevalent in XPF-R files. Among the investigated instruments, the XPF-R's were more likely to separate without warning, whereas XPS frequently exhibited plastic deformation, which could act as a pre-fracture forewarning sign during retreatment.

35. Parents' Perspectives after the Use of Silver Diamine Fluoride

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Objectives: The aim of the study was to explore the perspectives of parents whose children had active carious lesions in the primary dentition managed with the use of silver diamine fluoride (SDF).

Methods: Parents of children who had received at least two applications of silver diamine fluoride in both anterior and posterior primary teeth were invited to participate. An open-ended semi-structured questionnaire was used to guide the interview process. Eleven in-person interviews were completed and content analysis was used to code transcripts and identify themes.

Results: Parents did not express any major esthetic concerns about the color change in the primary dentition, mainly due to their children's young age and the transience of the dentition. Utilization of SDF alleviated parental distress associated with dental caries because it was a minimally invasive method of managing the disease. All parents found the use of a standard set of before-and-after photos enhanced the informed consent process in deciding to opt for the use of SDF.

Conclusions: Parents of children with dental disease are amenable to the use of minimally invasive management of caries in the primary dentition with silver diamine fluoride. Parents prioritize management of their children's oral health over unesthetic color changes, including primary anterior teeth. Use of before-and-after photographs is recommended as part of the informed consent process to prepare the family for the color changes resulting from the use of SDF.

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36. Role of SARS-CoV-2 Spike Protein in Human Endothelial Cell-Cell Fusion

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Objectives: COVID-19 is a multi-tissue disease caused by SARS-CoV-2 infections. Contrary to most other respiratory viruses, SARS-CoV-2 has a strong impact on the cardiovascular system. A spike (S) protein is required for virus particle entrance into host cells. It has been shown that virus infection also leads to syncytia, the formation of dysfunctional giant cells by cell-cell fusion. Here, we demonstrate that the expression of the S-protein alone, as induced by all gene-based COVID-19 vaccines, can induce cell-cell fusion in endothelial cells (ECs). Various modifications of the S-protein were undertaken to study their impact on cell-cell fusion.

Methods: The chemically synthesized and codon optimized gene construct of a SARS-CoV-2 spike (Wuhan variant, WV-S) in a mammalian expression vector (pTwist) was acquired from a commercial source. Using molecular biology tools, various parts of the S-gene likely required for cell-virus (or cell-cell) fusion events were modified. Plasmid constructs were then used to transfect human ECs.

Results: We demonstrated that the expression of WV-S, delta-S, and the double proline-prefusion-stabilized WV-version of the S-protein as used in the Pfizer and Moderna vaccines induced syncytia and the upregulation of various inflammatory cytokines. Empty vector-control or a S-protein receptor-binding-domain-deleted plasmid did not cause any cell fusion. Deletion of the fusion peptide region and modification of the furin-cleavage site led to a strong reduction of the fusion events without significantly affecting the expression of the S-protein on ECs.

Conclusions: Recombinant spike protein variants were expressed in human ECs and affected cell-cell fusion and the expression of inflammatory markers. Potential pathological consequences of S-protein expression in the endothelial system will need future evaluation in animal models. Discovering the structural and functional profile of S-protein involvement in cell-cell fusion may potentially improve future and less side-effect-prone vaccine developments.

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37. Can Surface Treatment and Surface Region Affect Zirconia Colour Stability?

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Objectives: The long-term colour stability of zirconia restorations when being exposed to different liquids in the mouth is unclear. The colour stability of zirconia may be linked to the surface treatment protocol used and the restoration surface region. Thus, we hypothesized that the surface treatment protocol and the restoration surface region can affect the colour stability of aged high-translucency monolithic zirconia. The aim of this *in vitro* study was to assess the effects of surface treatment and surface region on the colour stability of high-translucency monolithic zirconia following coffee thermocycling.

Methods: Thirty high-translucency monolithic zirconia disk specimens (0.5 mm thickness, 10 mm diameter) were divided into three groups based on the surface treatment applied: adjusting (A), polishing (P), and glazing (G). Specimens were cemented to composite backgrounds and thermocycled 10,000 cycles in a coffee solution. Colour coordinates were measured with a spectrophotometer before and after thermocycling in the central and marginal surface regions of the specimens. ΔE_{00} color difference values were calculated and compared with the visual thresholds for perceptibility ($\Delta E_{00}=0.8$) and acceptability ($\Delta E_{00}=1.8$) to elucidate the specimens' color changes owing to coffee thermocycling. Repeated measures of ANOVA and Bonferroni tests were used for data analysis ($\alpha=.05$).

Results: Mean ΔE_{00} values ranged from 0.72 to 1.26. The surface treatment affected the ΔE_{00} ($p=.005$), while the surface region ($p=.499$) and the interaction of surface treatment and surface region ($p=.998$) did not affect the ΔE_{00} . The mean ΔE_{00} values were less than 0.8 for the G group, but greater than 0.8 and less than 1.8 for the A and P groups.

Conclusions: The surface treatment protocol can impact the colour stability of aged zirconia, but the surface region cannot. Among the three surface treatments tested, glazing offers imperceptible colour changes, thus providing the best colour stability for high-translucency monolithic zirconia following coffee thermocycling.

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38. Calcified Carotid Artery Atheroma on Standard Dental Radiographs: Retrospective Study

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Objectives: Calcified carotid artery atheroma (CCAA) can be identified incidentally on standard panoramic dental radiographs (PANs). Contemporary guidelines specify that documented carotid artery disease is a statin-indicated condition, as these individuals are at elevated risk of future cardiovascular events.

Methods: In this pilot study, we screened subjects aged ≥ 30 with a PAN from May 2019 to April 2021 from the UBC Dental Clinic. Patient charts were reviewed for existing statin-indicated conditions as outlined by the Canadian Cardiovascular Society 2021 Guidelines. Additionally, PANs for each subject were evaluated for the presence and characteristics of CCAA and presence and extent of periodontal disease. We then examined the prevalence of subjects with CCAA on PAN.

Results: Out of a total of 376 subjects with a PAN, 12 were excluded for lack of documented medical history. Of the remaining 364, 161 were female (44%) and the mean age was 60.2 ± 16.5 years. As these radiographs were performed for dental indications, only 187/364 (51%) were diagnostic for evaluation of CCAA. Thirty-eight (10.4%) individuals had evidence of CCAA on PANs, the location for 30 subjects i.e., 78.9% was below and behind the hyoid bone. Some subjects (50%) with CCAA were noted to have CCAA's present bilaterally. Additionally, only 3 (0.07%) were diagnosed by the student dentist! Periodontal disease was observed in 15 (39%) of the positive CCAA PANs wherein 60% had generalized and 40% had localised periodontal disease. Out of those with CCAAs, 8 (21%) were already on lipid-lowering therapy for a pre-existing condition and 9 (24%) were not on lipid-lowering therapy but had a pre-existing condition that would have warranted treatment. Twenty-one (55%) were not on lipid-lowering therapy and did not have a pre-existing condition.

Conclusions: This project will lay the foundation for future work examining the impact of formalized shared care pathways between dentists and physicians.

39. Effect of Manipulation of Leucocyte-Platelet Rich Fibrin on Membrane Quality

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Objectives: Leucocyte and platelet rich fibrin (L-PRF) is a membrane containing fibrin matrix with platelets and leucocytes made via centrifugation of blood, used for wound healing applications in clinical practice. L-PRF has been shown to regulate wound healing related gene expression in gingival fibroblasts. We hypothesized that greater elapsed time between blood collection and centrifugation would be associated with smaller L-PRF membranes and altered expression of wound healing related genes in L-PRF-stimulated gingival fibroblasts.

Methods: Blood samples were collected from 16 healthy individuals followed by immediate centrifugation (T-0) or after 1-, 2-, 4-, and 6-minute storage at room temperature. L-PRF was isolated from each sample and size measured by weighing with a precision balance. Samples from T-0 and T-6 were each incubated 48 hours in cell culture medium (DMEM) at 37°C to create L-PRF releaseate. Gingival fibroblasts were incubated 48 hours with L-PRF releaseate, followed by RNA isolation and RT-qPCR to measure expression of select genes (MMP-1, MMP-3, Collagen1, VEGF-A, FGF-2, IL-6, IL-8, IL-1 β and TNC).

Results: Immediate centrifugation resulted in the largest membrane for each participant. There was large individual variation in membrane sizes; range of masses for T-0 membranes was 1.252 g to 2.322 g and for T-6 membranes 0.570 g to 1.858 g. T-6 membranes were typically the smallest in size, being on average 26% smaller than T-0 membranes. Preliminary data regarding gene expression suggest that there is significant variation in fibroblast response to individual L-PRF releaseates. Furthermore, the expression response is reduced with T-6 compared to T-0 membranes.

Conclusions: Longer elapsed time between blood collection and centrifugation generally resulted in smaller L-PRF membranes, with significant individual variation. Storing blood for 6 minutes before centrifugation seems to lower the biological effect of the L-PRF membranes. Thus, immediate centrifugation appears to result in optimal quantitative and qualitative properties of L-PRF for clinical use.

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40. E-Cadherin and Beta-Catenin Expression in Oral Dysplasia

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Objectives: Epithelial-mesenchymal transition (EMT), a biological process characterized by a decrease in epithelial features and increase in mesenchymal traits, has been suggested as a crucial mechanism in cancer development. A key feature of EMT is the loss of E-cadherin—a cell-surface protein involved in epithelial cell-cell adhesion. E-cadherin potentially contributes to malignant progression via beta-catenin signaling through the Wnt pathway. E-cadherin and beta-catenin expression is altered from normal oral tissue, oral epithelial dysplasia (OED), to oral squamous cell carcinoma (OSCC), but there is no longitudinal research on the role of these biomarkers in malignant progression. This study aimed to explore the expression of E-cadherin and beta-catenin in OED and to determine whether these expression patterns predict malignant progression.

Methods: Twenty-eight progressors (PR) and 56 non-progressors (NPR) were included in this case-control study. Samples that progressed to severe OED, carcinoma *in situ*, or OSCC were PRs, and samples that did not progress were NPRs. Patient samples with a baseline biopsy of low-grade OED were obtained from the Oral Cancer Prediction Longitudinal study. Immunohistochemistry was performed on formalin-fixed paraffin-embedded tissue samples to assess for reduced membranous E-cadherin, and reduced membranous and increased cytoplasmic and/or nuclear beta-catenin expression in PRs compared to NPRs. Fisher's exact test was used. Logistic regression will predict progression.

Results: There were no significant differences in age, sex, risk of lesion site, and grade of dysplasia between PRs and NPRs. There were significant differences in length of follow-up time and smoking history. Immunohistochemistry has been completed on 20 samples, which show a trend toward decreased membranous beta-catenin in PRs compared to NPRs ($p=0.051$). Additional samples will be assessed for prediction of progression.

Conclusion: This research enhances the understanding of EMT's role in malignant progression and potentially aids in the intervention of oral lesions at risk of cancer.

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