BSODR NEWCASTLE UPON TYNE | 2024

British Society of Oral and Dental Research
2nd – 4th September 2024

Book of Abstracts

BSODR
BRITISH SOCIETY FOR ORAL AND DENTAL RESEARCH
IADR British Division

Colgate

Newcastle University

Contents Page

Page 3 – 5 Welcome

Page 6 Local organising committee

Page 7 – 174 Abstracts ordered by abstract number

Page 175 Sponsors

Page 176 – 179 Presenting authors listed in alphabetical order

Welcome from the President of BSODR

It is my pleasure to add my welcome as President of BSODR, thank you for supporting our annual meeting with your attendance in Newcastle.

Having been involved with the organisation of the meeting in Sheffield in 2011, I know how much work goes into organising this conference so I must give heartfelt thanks to those who have made this possible including the Head of Newcastle Dental School, Dr Chris Nile and the local organising committee, Beaconhouse Events and our sponsors.

Our annual meeting is a key event for us and provides an opportunity to learn of recent developments in the field, present your own research, network and socialise with colleagues from other Institutions. I urge you to actively take part in all of the above and hope you all have an enjoyable and fruitful time in Newcastle. Finally, please make a note of our Early Career Researcher conference in Cardiff on the 26th March 2025, details of which will be circulated during this meeting.

Professor Simon A. Whawell, Peninsula Dental School Plymouth.

Welcome from Newcastle University

I am delighted to welcome you to Newcastle for the 2024 British Society for Oral and Dental Research Annual Scientific Meeting.

Dr Chris Nile and the organising committee have pulled together an inspiring programme of scientific and social events which showcase the very best of oral and dental research going on across the UK as well as showing off our amazing city and region. Our university strapline is "From Newcastle, for the world" and I hope that the meeting will reflect this with the work presented here impacting globally.

I am so proud to call this city home and I hope you will have some time to experience the legendary Geordie welcome and the beauty, history and vibrant culture of the city and region. I would like to extend my sincere thanks to Chris, the wider local organising committee, the team at BSODR, our conference organisers, Beaconhouse Events as well as our event partners, Colgate (joining BSODR and Newcastle University) and sponsors SDI and Listerine. I look forward to catching up with friends old and new over the course of the meeting so do come and say hello!

Professor Chris Vernazza, Head of School of Dental Sciences, Newcastle University

Welcome from the Local Organising Committee

On behalf of the local organising committee, I wish to extend my warmest welcome to BSODR2024 and the beautiful city of Newcastle upon Tyne. It doesn't seem 2 minutes since we agreed to host this year's annual meeting and I think all the committee are relieved it is finally upon us! Indeed, I don't think any of us will ever complain about a conference again given our new appreciation of the hard work that is required to organise such an event. That said, our hats go off to all previous organisers, many of whom will be attending this year, and those who come after us.

It takes a team effort to organise such an event and I'd like to thank all the members of the local organising committee, the BSODR management committee and especially Beaconhouse Events. In addition, I'd also like to thank our event partner, Colgate and our sponsors SDI and Listerine. Lastly thanks to all the presenters (especially those who have travelled a great distance to be here), session chairs, prize judges, symposia leads and of course attendees, without whom this meeting would not be possible. I'm sure over the next 3 days there will be lots of interesting scientific discussion and I hope this leads to new projects and collaborations.

Finally, although many of the local organising committee were not born in Newcastle it is very much a city we are proud to call 'home'. Therefore, as well as enjoying the scientific programme we have in stall, I hope you get to experience the city, the famous Geordie welcome and of course its nightlife.

Dr Chris Nile, Chair of the Local Organising Committee, Newcastle University

Local Organising Committee

Dr Luisa Wakeling

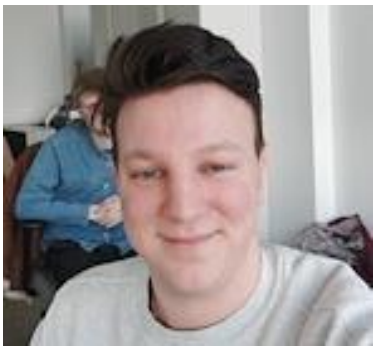
Dr Richard Holliday

Prof Nicholas Jakubovics

Mrs Jill Lloyd

Dr Greig Taylor

Dr Matthew German



Mr Jordan Godfrey

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BSODR 2024 Abstracts

8

Fluctuating Daily Urinary Fluoride Concentrations in Fluoridated and Non-fluoridated Areas

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Abstract

Objectives: Due to the challenges of collecting 24-hour urine samples for monitoring fluoride exposure in children, spot urine (SU) has been suggested as an alternative collection method. However, urinary fluoride concentration (UFC) may vary during the day. This study aimed to evaluate the daily fluctuation in UFC in naturally fluoridated (FA) and non-fluoridated (NFA) areas of the UK. **Methods:** SU samples were collected from healthy children, aged 4-6y, living in FA (n = 28) and NFA (n = 36) areas of the UK. Participants provided four SU samples: (i) fasting (ii) 3h after breakfast, (iii) 3h after lunch, and (iv) last urine before going to bed. Samples were analysed in triplicate, using an F- ion-selective electrode and direct method. **Results:** Mean (SD) fluoride concentration of tap water was 1.232 (0.057) and 0.107 (0.031) µg/g for FA and NFA, respectively. The highest mean (SD) UFC of 1.460 (0.618) µg/g during fasting and the lowest of 1.218 (0.604) µg/g 3h after lunch were recorded in the FA. The highest mean (SD) UFC of 1.442 (1.729) µg/g 3h after breakfast and the lowest of 1.141 (1.105) µg/g 3h after lunch were recorded for the NFA. Daily variation in UFC ranged from 0.373 to 3.997 µg/g and 0.058 to 8.869 µg/g for FA and NFA, respectively.

Conclusion: This study evaluated the daily fluctuation in urinary fluoride concentration for FA and NFA. The wide fluctuations in daily urinary fluoride concentration highlight the need to collect SU samples at several timepoints throughout the day.

and

9

An Exploratory Study of Maternal Health and Socioeconomic status and offspring use of dental services – Northern Ireland National Cohort Study

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[1]Queen's University Belfast, Belfast, United Kingdom. [2]Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai, UAE

Abstract

Introduction: A small number of literature has posited a link between prenatal exposure to gestational diabetes mellitus and an increased risk of developmental defects in the enamel of offspring. However, the evidence remains inconclusive.

Aims: This study examined the relationship between the diabetes status of mothers and the use of dental services by offspring to that pregnancy.

Material and methods: Anonymised data from a cohort of mothers who carried a child to term in Northern Ireland between 2012 and 2017 and service use by the child were taken from administrative databases from March 2015 to September 2021. Descriptive statistics, differences in means and regression analyses were used to examine the relationship between service use and maternal diabetes status, controlling for covariates.

Results: In multivariate analyses that controlled inter alia for age and deprivation, diabetes status and use of antidepressants during pregnancy were negatively related to restoration, extraction, prevention, and total service use. In the analysis of the COVID period, pre-COVID prevention was negatively related to extractions, restorations, prevention, and services in general.

Conclusion: The relationship between maternal diabetic status and aspects of offspring use of dental services was contrary to that suggested in previous studies and warrants more detailed investigation using this valuable data resource.

10

Epidemiological Retrospective Study to Analyze UAE Children Oral Health Status

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Abstract

Aims & Objectives:

A retrospective study to evaluate the dental caries status of students in grade 1, 7 and 10 in United Arab Emirates (UAE) government schools covered by Ministry of Health and Prevention (MoHAP).

Methodology:

This study reviewed and analysed secondary database which was collected by national oral health screening program. In UAE, the dental department at the Ministry of Health and Prevention (MOHAP) has conducted oral health screening sessions for students in grades 1, 7 and 10 between 2015 and 2019.

Results:

During 2015/2016, 22,580 students were screened out of 22,960 students enrolled in grades 1,7 and 10 with 68.8% caries incidence. For 2016/2017, 28,608 students were screened out of 29,213 with 76.2% caries incidence. For 2017/2018, 30,560 students were screened out of 31,375 with 67.1 % caries incidence. During the academic year 2018/2019, a total of 29,181 students were screened out of 30,654 students in grades 1,7 and 10 with 52.8 %. caries incidence. During 2019/2020, a total of 20,559 students were screened out of 24,547 students in grades 1,7 and 10 with 38.45% caries incidence.

Conclusion:

The overall caries Incidence in UAE was high during 2015-2019 which declined by the end of this period where Dubai had the lowest rate; and Grade 1 had higher caries incidence than grade 7 and 10. Also, there was no significant difference in Caries incidence between male and female.

11

The Perspective of Oral Healthcare Providers on Oral Health Promotion and Disease Prevention Programmes in UAE

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Abstract

Objective:

To measure the UAE dentists' awareness and perspectives on oral health promotion and disease prevention programmes and their impact on oral health on the UAE community through qualitative analysis.

Material and methods:

Semi-structured online interviews were conducted with a sample of 6 Dentists in a managerial role, 10 specialists/consultants and 10 GDPs from MOHAP. Interviews were digitally recorded and transcribed verbatim. An iterative coding process using theme-analytic methods was used.

Results:

The data was characterised into four major themes— the awareness and engagement of oral prevention programmes, policies, data/outcomes, and challenges. Three minor themes were identified: covid impact on oral prevention programmes, oral preventive programmes training and patient information system. The three groups are aware that there are preventive programmes running at MOHAP, but the level of knowledge and engagement differ from full engagement and participation by the GDPs to general awareness and no involvement by the specialists/consultants as it is part of the primary care. Furthermore, the major challenges are the busy clinics, dentist knowledge and patients' awareness but the patient information system and documentation policy contain the elements that support oral prevention care for the patients. The COVID impact was observed but not measured.

Conclusion:

The dentists in this study identified the need to have preventative programmes involving all oral health care providers and supported clear strategies and policies that serve the different categories in the community.

12

Plant-derived Nanoparticles Guiding Stem Cells to promote Bone Regeneration

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Abstract

Background: Poly (l-lactide-co-ε-caprolactone) scaffolds functionalised with RG-I (rhamnogalacturonan-I) pectin isolated from potato, can modulate inflammation, and promote bone regeneration both in vitro and in vivo, whilst RG-I and Galectin-3 (LGALS3) are hampering the inflammatory response from immune cells.

Aim: Identify how RG-I pectin-based coating, might affect individual genes/pathways using an in silico analysis and link them to Galectin-3 (LGALS3) expression.

Methods: Potato RG-I was enzymatically modified to produce RG-I dearabinated (PA) for use as surface coating. Human mesenchymal stem cells were isolated from bone and cultured on PA coated and control (uncoated) tissue culture polystyrene surface. Transcriptomic profiling (Illumina) identified 43 genes differentially expressed (DE) between control and PA coating with false-discovery rate >0.1. Ingenuity pathway analysis (IPA) was performed to identify pathways and gene networks in relation to LGALS3.

Results: Analysis for diseases and functions of the DE genes showed implication for organismal disorders-abnormalities, connective tissue disorders, immunological and inflammatory diseases, and inflammatory response. Three networks were identified by IPA with genes involved in: (1) organismal injuries and abnormalities, cancer, cellular assembly, and organisation; (2) cellular function and maintenance, growth, and proliferation; (3) DNA replication, recombination, and repair. Networks 1 and 2 showed similar scores and focus molecules, however LGALS3 gene was only expressed in Network 1.

Conclusions: In silico analysis highlighted the involvement of several genes including LGALS3 cellular, inflammatory, and immunological functions; further investigations are required into the different molecular and/or cellular pathways to establish the significance of using the functionalised RG-I PA scaffolds.

14

Dysbiosis-mediated inflammation: a pathophysiological link between rheumatoid arthritis and periodontitis

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Abstract

We aimed to explore the link between rheumatoid arthritis (RA) and periodontitis (PD) through the lens of microbial dysbiosis.

Meta-taxonomic analysis of the subgingival biofilm from 100 volunteers with RA and PD, 22 with RA, 18 with PD alone and 19 healthy controls revealed periodontal dysbiosis in RA patients even prior to the onset of periodontitis.

Individuals with periodontitis demonstrated a robust positive correlation between the severity of periodontitis and RA disease activity, with RA superseding periodontitis severity as a determinant of microbial dysbiosis. Higher serum antibodies to oral pathogens were recorded in RA subjects than controls. Intensive non-surgical periodontal therapy (SRP) restored subgingival host-microbial homeostasis within 3 months. This was accompanied by significant decreases in serum antibodies to microbial antigens after 3- and 6-months. Clinical metrics of RA activity also demonstrated appreciable, but nonsignificant improvements in the SRP cohort when compared to controls.

Thus, our data suggests that periodontal therapy can impact the pathophysiology of RA by restoring subgingival eubiosis, reducing local and systemic inflammation, and decreasing circulating antibodies to periodontal pathogens. This signposts the importance of periodontal care in RA management pathways and emphasizes the need for closer working relationships between rheumatologists and oral healthcare professionals.

16

Optimising A Whole-Exome Sequencing Data Analysis Pipeline For The Identification Of Novel Genetic Variants In Amelogenesis Imperfecta

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Abstract

Amelogenesis imperfecta (AI) is a group of rare genetic disorders affecting dental enamel appearance, structure and function. Whole-exome sequencing (WES) analyses can determine molecular diagnoses in many AI cases, but a significant proportion remains unsolved. This project aims to re-analyse existing WES data using an updated analysis pipeline to identify previously unrecognised genetic variants associated with AI. Existing WES data from 96 AI participants were re-analysed using the hg38 human reference genome, along with the updated version of the dbSNP (Single Nucleotide Polymorphism Database) and CADD (Combined Annotation Dependent Depletion) databases. The variants were annotated by Ensembl VEP (Variant Effect Predictor) and filtered by the VASE (Variant Annotation, Segregation and Exclusion) programme. Four of the identified variants underwent further genetic analyses and Sanger sequencing. As a result, 147 candidate variants were identified, from which 52 variants were not recognised during the previous analysis using the hg19 reference genome. A novel homozygous *ACP4* missense variant c.254T>C; p.(Leu85Pro) was identified and segregated in families AI-B77, AI-B94, and AI-C66. Three heterozygous variants *AMBN*: c.743C>T; p.(Ala248Val), *LAMA3*: c.9268C>T; p.(Arg3090Trp), and *LTBP3*: c.2749_2751del; p.(Lys917del) were validated by Sanger sequencing in families AI-A47, AI-B78, and AI-B76, respectively. In conclusion, the hg38 pipeline demonstrated an improved ability to detect genetic variants from known AI genes, giving the potential to aid the molecular classification of AI. The association of the newly identified variants to AI pathogenic mechanisms and clinical phenotypes adds value to the genetic discoveries.

17

The psychometric evaluation for the reliability and validity of a cross-culturally adapted PoSSe scale

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Abstract

The postoperative symptom severity (PoSSe) scale, which was developed in the UK, measures the impact of postoperative morbidity on patients' quality of life after lower third molar surgery. It has recently been used in Chinese populations but without having been adapted and validated for these populations. Based on our previous work, a Chinese version of the PoSSe scale for applications in third molar surgery in Chinese patient populations, has been cross-culturally translated and adapted. The aim of this study was to psychometrically evaluate its reliability and validity. The psychometric evaluation took place in a sample of 101 patients undergoing lower third molar surgery in Tianjin, China. The tested scale demonstrated excellent internal consistency (Cronbach's α = 0.80 for the whole sample; α =0.80 among patients with bone removal during surgery; α =0.81 among patients without bone removal during surgery). For external validity, PoSSe scores had statistically significant associations with the extent of surgical trauma (osteotomy and duration of surgery), self-reported pain and clinically assessed trismus. The strength of these associations varied between the two groups (with and without bone removal during surgery) in the expected direction. The results suggest that the Chinese version of the PoSSe scale showed excellent internal consistency and validity and can be confidently used for clinical and research applications in Chinese patient populations.

18

The effect of decontaminating rotary brushes on implant surface topography: an in vitro study

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Abstract

Objective: Mechanical decontamination of the implant surface is a crucial step in the management of peri-implant diseases. Recently, dental professionals are increasingly using rotary brushes to decontaminate the implant surface. This study investigated the effect of commercially available brushes on the implant surface topography.

Methods: Twenty-five titanium discs (n=5/gp) were prepared to produce sandblasted and acid-etched surfaces (SLA) of moderate roughness. Four commercially available brushes were used to clean the discs- group 1: iBrush, group 2: NiTiBrush, group 3: Labrida BioCLean, group 4: Peri-implantitis Brush, and group 5: no treatment. Each disc was instrumented for 60 seconds under copious irrigation following the manufacturer's guidelines.

The gross surface alterations were observed with the naked eye and photographed. The topographic surface evaluation was performed using a field emission gun scanning electron microscope (FEG-SEM). A 3-D optical surface profilometer was used to assess the surface roughness.

Results: a) Upon gross examination, all treatment surfaces showed significant macroscopic surface alterations in the form of scratches, except for the Labrida BioClean group. b) SEM evaluation showed significant surface alterations on all treatment surfaces, except for the Labrida BioClean group, which preserved the original surface structure. Additionally, remanent debris was observed on all treatment surfaces. c) Surface roughness evaluation showed that all treatment surfaces, except for the Labrida BioClean group, showed a statistically significant reduction in the average surface roughness ($p<0.05$) compared to the control group.

Conclusion: All tested rotary brushes, except for the Labrida BioClean brush, produced significant macroscopic and microscopic surface alterations.

19

A comparison of the effects on bone tissue of two ultrasonic cutting devices operating at different frequencies

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[1]University of Edinburgh, Edinburgh, United Kingdom. [2]University of Glasgow, Glasgow, United Kingdom. [3]Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Abstract

Introduction: A key limitation of Ultrasonic (US) bone cutting is the heat generated by friction between the bone and the blade, which leads to cell death at the incision site, and the potential formation of microcracks.

Aim: To explore the effect of different frequencies and tip displacements of US cutting devices on the amount of thermal and mechanical damage.

Methods: In vitro US cutting tests were conducted on 12 fresh rat femoral shafts using two different frequencies; 20kHz and 35kHz at different displacement amplitudes with irrigation. Histological examination was performed to identify live and dead cells. Micro-damage were identified using Micro-CT and confocal Laser scanning microscope. Significant inter-group variations were found through one-way ANOVA ($p < 0.05$).

Results: Histological examination revealed a high incidence of cell death at the cutting edge, in both frequencies. The highest cell death percentage ranged from 25% (at 35kHz, 18.7 µm (p-p)) to 44 % (at 35kHz, 27 µm (p-p)). Most of the tool's effect was located within 25 µm of the cut surface. There was a significant decrease to < 5 % at 200 µm. No cell death was found over 200 µm from the cut surface in both frequencies. No microcracks were detected along the depth of the cut site at either frequency.

Conclusion: Of the 2 ultrasonic cutting frequencies tested, the combination of the higher vibration frequency (35kHz) and the lower displacement amplitude (18.7 µm (p-p)) demonstrated least damage to the bone tissue. No microcracks were displayed when using either of the US cutting frequencies.

20

Why aren't we doing better? Are dentists and dental students prepared to support patients with lived experience of intimate partner violence and abuse?

Sarah Farmer, Janice Ellis, Hayley Alderson

Newcastle University, Newcastle Upon Tyne, United Kingdom

Abstract

Intimate partner violence and abuse (IPVA) is a public health crisis with long term implications for an individual's mental and physical health. IPVA can result in head and neck trauma, including oral injuries, placing dentists in a unique position to be able to identify at risk patients. It is therefore important to understand any barriers dentists may experience when supporting IPVA patients.

The aim of this study was to explore whether dentists and dental students are prepared to support patients with lived experience of IPVA. This study adopted a qualitative cross-sectional research design using focus groups and interviews. Data was collected using the principles of grounded theory and analysed using thematic analysis.

Data was collected from 14 dentists and 22 dental students. Results showed that dentists and dental students did not feel confident or prepared identifying and responding to patients they suspected were experiencing IPVA. Barriers included a lack of practical knowledge and fear of 'getting it wrong' resulting in professional paralysis.

Improving current safeguarding educational frameworks and perhaps reframing education on IPVA as a core subject at both undergraduate and postgraduate could be key to enhancing the confidence and practical knowledge of dental practitioners to improve patient safeguarding.

21

Exploring the impact of oral health and microbiome on infective endocarditis

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Abstract

Infective Endocarditis (IE) is a severe infection of the endocardium, primarily caused by microbial agents from various niches including the oral cavity. This life-threatening condition may be influenced by the oral microbiome, a potential source of recurrent bacteraemia exacerbated by common dental procedures. Patients with active, unstable periodontitis face heightened risks of bacteraemia from routine tooth-brushing, potentially leading to heematogenous spread of oral pathogens. This study uses a clinical case report to discuss IE in relation to oral health.

A 70-year-old male with a history of multiple chronic conditions including pulmonary embolism and chronic hepatitis. Subsequent investigations revealed a Staphylococcal vegetation on his mitral valve, an echocardiogram positive for IE, elevated CRP levels, and blood cultures positive for *Staphylococcus aureus* bacteraemia, leading to a diagnosis of definitive IE (modified Duke criteria). The patient's oral examination showed generalised severe periodontitis with a rapid rate of progression (Stage IV, Grade C) currently unstable, oral thrush, extensive dental caries, and other significant dental pathologies. Saliva samples were collected and processed in compliance with the UK Human Tissue Act (HTA #12521), ethically approved by the UK National Research Ethics Service (REC 20/EE/0241, IRAS number 275079). Metagenomic sequencing identified a predominant *Staphylococcus* presence in the oral microbiome and a notably reduced microbial diversity.

These findings support the recommendation for routine dental assessments during hospital admissions, particularly before cardiac surgery, to mitigate potential oral sources of infection. Effective multidisciplinary collaboration and communication between dental and healthcare teams are essential to optimise patient outcomes in IE management

22

From mouth to foot: exploring how bacteriophage sourced from diverse environments can improve human health

Graham Stafford

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Abstract

Since their discovery in the early 20th century the swarms of antibacterial viruses that surround us in the environment have generated interest for discovery bioscience and as potential antibacterials. Their existence in the oral cavity, once considered a myth, is now well established- both in the metagenome dark matter, but also via an increasing number of isolated phage targetting oral spp. of *Fusobacteria*, *Porphyromonas*, *Streptococci* and *Enterococci*. This talk will review recent discoveries in the literature and present data from our lab on isolation and characterisation of phage against a range of Enterococci and other spp. Finally, I will present the case for phage applications and explain the potential use of phage from the oral microbiome for Diabetic Foot Ulcers. I will also explain how a trip to the zoo changed the direction of our research.

23

Experiential insights into the nature of pain at a family-focused event

Jamie Coulthard[1], Niki Jones[2], Chris Penlington[3]

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Abstract

Introduction

The experience of pain is common in dental settings, and requires expert management. Fear of pain may account for a large proportion of dental anxiety. Longer-term pain may be misattributed to dental problems in individuals who are dentally healthy, leading to inappropriate treatment and dissatisfaction.

An accurate understanding of pain is key to opening-up promising new approaches to both pain-related procedural anxiety and persistent pain. It has been suggested that active and experiential methods of learning may be effective for building this understanding.

Methods

Experiential sensory experiments will be prepared, alongside true stories of pain experiences and delivered to participants of a public engagement event targeted to families in North East England. Participants will be asked to try out sensory experiences that illustrate common discrepancies between "felt senses" and objective reality, and to reflect on what their experiences might tell them about pain. Participants will be asked to use coloured counters to indicate whether they believe that pain predominantly reflects objective tissue damage before and after engaging with the station.

Results

Results will indicate the beliefs of a family audience about pain and whether these beliefs can change after engaging in a brief experimental station.

Conclusion

Public engagement offers important opportunities to support an improved understanding about the nature of pain. Such an understanding has the potential to transform dental care in relation to both acute and persistent pain presentations.

24

Exploration of Syrian refugees' experience of accessing dental health services in Scotland: A mixed-methods Study

Elaf Asfari[1], Andrea Rodriguez[1], Siyang Yuan[1], Arek Dakessian[2]

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Abstract

Researcher: Elaf Asfari

Supervisors: Dr.Siyang Yuan, Dr. Andrea Rodriguez and Dr Arek Dakessian.

Title: Exploration of Syrian refugees' experience of accessing dental health services in Scotland: A mixed-methods Study

Aim

To explore Syrian refugees' experience in accessing dental health services in Scotland.

Objective

The specific study objectives are:

1. To explore the barriers and enablers of accessing dental health services among Syrian refugees in Scotland.
2. To explore the dental health professionals' (DHPs) experience in dealing with this population in Scotland
3. To explore the kind of help that refugees get to access dental health services from parties/organisations which support refugees in Scotland.

Methods

[1] Scoping review: to explore refugees' experience in accessing dental health services in Scotland

[2] Investigation of Syrian refugees' access to dental health services in Scotland: A mixed-methods study

1. A qualitative exploration

1. Interviews with Syrian refugees
2. Interviews with refugee organisations' stakeholders.
3. Interviews with dentists to evaluate their experience working with this population

1. A questionnaire development

Survey with Syrian refugees in Scotland.

Discussion

The scoping review findings explored the challenges refugees encounter when trying to access dental services in host countries. The limited availability of relevant research highlighted the necessity for a mixed methods study. Initial findings from the mixed-methods study indicated that Syrian refugees in Scotland encounter various obstacles when seeking dental care, such as language barriers, costs, and lengthy appointment wait times. Dentists also face challenges as refugees have high expectations for dental treatment quality while navigating NHS coverage.

25

Assessing the Remineralisation Potential of Keratin on Erosive Tooth Wear Lesions

Prema Sukumaran, Sherif Elsharkawy, David Bartlett

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Abstract

Objective:

To explore if keratin, applied to polished enamel, can remineralise after erosion.

Methodology:

Polished human enamel samples were eroded in 0.3% citric acid at pH 2.7 for 20 mins and mean step height (SH) and knoop microhardness (KHN) taken. Samples were randomly assigned to (n=11) 10% Keratin (K), 10% Keratin with 7.48µl Triethylene glycol dimethacrylate (KT), sodium fluoride solution (NaF) at 1450 ppm. A single application of K, KT and NaF was applied, and control (C) group had no application. All samples were fully immersed in artificial saliva (AS), unstirred, at 37°C for 7 days of incubation and mean SH and KHN retaken. The samples were then re-challenged in citric acid and measurements repeated.

Results:

Baseline SH and KHN after erosion were -5.66µm (SD 0.16) and 249.08kgf/mm (3.95). Post incubation, measurements for K was 6.55µm (9.44) & 52.37 (26.73), KT 5.30µm (10.40) & 57.31 (54.24), NaF 4.11µm (3.90) & 61.49 (29.36) and for C 9.40µm (16.37) & 116.29 (123.87). After final erosion, measurements for K were -3.84µm (4.53) & 107.12 (41.23), KT -6.32µm (6.61) & 96.75 (30.10), NaF -2.45µm (1.32) & 199.14 (77.24), C -8.47µm (1.89) & 190.83 (27.64), respectively.

After first erosion and post incubation, there were no significant differences in SH and KHN between groups ($p>0.05$). After final erosion, there was significant differences in SH between C and NaF ($p<0.05$). For KHN significant differences were observed between control and NaF with both K and KT ($p<0.05$).

Significance:

Keratin facilitated rebuilding and protection of eroded enamel from subsequent acid challenge.

26

Biosynthesis pathways for the large-scale production of rhamnolipid isomers for dispersing multi-species oral biofilms.

Pavlos Trus

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Abstract

Oral biofilms cause dental caries which is one of the most prevalent oral diseases, affecting 2.3 billion people worldwide. Currently, the best way to effectively remove biofilms from dental surfaces and to reduce the risk of developing dental caries is via mechanical plaque control. There is a need to develop environmentally friendly and effective ways to remove biofilms from dental surfaces where it is difficult to access through physical removal. Rhamnolipids (RL) are glycolipid biosurfactants produced mainly from *Pseudomonas aeruginosa* through the *rhl*AB and *rhl*C operons. This study aimed to develop a novel chemical process utilizing RL to inhibit bacterial aggregation and early colonisation, as well as, removing mature biofilms from the tooth surface. In addition, to testing the antimicrobial properties of RL this project aimed to increase the activity of the rhamnosyltransferase reactions via enzyme engineering. A bioinformatic pipeline was developed to collect *rhl*ABC gene sequences from 5,850 *Pseudomonas* genomes from bacterial genomic databases and analyse their polymorphic variations using a series of hyperparameters to increase enzyme activity, with the predominant focus being on the first-rhamnosyltransferase reaction. Different *rhl*AB configurations were expressed using an arabinose induction platform in *Escherichia coli* to determine their mono-RL production, which resulted in a *rhl*B sequence being identified with a three-fold increase in production output. To further test their antimicrobial activity and their effectiveness in dispersing oral biofilms, a polymicrobial biofilm model composed of three oral microbes *Streptococcus mutans*, *Actinomyces oris* and *Veillonella parvula* was developed using artificial saliva media supplemented with simple carbohydrates.

27

Mechanical and Topographical Changes on Dentine Following Citric Acid Exposure

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Abstract

Erosive tooth wear (ETW) affects people of all age groups, where clinical pathological changes are normally only diagnosed once dentine has been irreversibly exposed. Prevalence rates continue to rise globally, which is strongly linked to the increased consumption of common dietary acids. However, the effects of dietary acids on dentine during intra-oral consumption times remains poorly understood, which limits the development of preventative ETW measures. This *in vitro* study investigates the effects of citric acid on selected dentine properties, following short exposures.

Human dentine specimens underwent erosion cycling, with repeated 20s exposures, to either 1% or 6% citric acid (CA) in buffered and unbuffered preparations, with a total exposure time of 2min. Changes to the surface morphology, roughness (Sa), and stiffness were continually monitored using atomic force microscopy (AFM).

The 6% unbuffered CA had the greatest impact on morphological, Sa, and stiffness measurements, whereas 1% buffered CA had the least erosive changes. The 1% unbuffered group was significantly more eroded than 6% buffered samples, for all AFM measurements. Peritubular and extrafibrillar mineral were lost at the same rate during erosion. In comparison, the intrafibrillar mineral remained intact for all samples, except the 6% unbuffered solution where 5-10% demineralisation had occurred after 2min exposures.

This research demonstrates that pH is more critical for erosive changes on human dentine, compared with concentration, which is an important dietary factor most relevant to commercially available soft drinks. Intrafibrillar mineral was afforded the greatest level of protection from erosion, compared with the other mineral sites.

28

Association of Tooth Colour Changes with Aging

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Abstract

Objectives: The objective of this study was to investigate the relationships between tooth whiteness, yellowness, and shade with respect to age.

Methods: Tooth colour of the upper maxillary central incisors of 278 individuals aged 18-65 in five clinical studies was measured using a clinically validated custom-built dental imaging system (VDIS). Inherent tooth colour was measured and presented by the colour coordinates in CIELAB colour space, then the corresponding tooth whiteness index (WIO), yellowness index (YIO) and shade values (based on a Vita 3D Shade Guide) were calculated. A linear regression model was derived to quantify the relationships between tooth whiteness, yellowness and shade with subject age.

Results: Using the linear regression model, it was calculated that for every year increase in age, tooth whiteness reduced by 0.557 WIO units, tooth yellowness increased by 0.556 YIO units, and tooth shade was 0.277 units darker, as measured by VDIS.

Conclusions: Teeth became darker and yellower with increasing age. Whiteness and yellowness changes with age for natural teeth can be predicted with linear regression models.

29

Reducing oral health inequalities or maximising population oral health? The public perspective on priorities for NHS dental services in England

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Abstract

Background: Dentistry in England is at a critical juncture. The scope of services available from the National Health Service (NHS) is theoretically broad, and can be used by any English citizen, yet the reality is that members of the population are unable to access timely and affordable dental care. During dental contract reform there has been little explicit consideration about the social values NHS dentistry should reflect. This is an important consideration given persistent oral health inequalities in England, and that dental services which fairly compensate the profession and reduces oral health inequalities will be costly.

Methods: To investigate if inequality reduction should be prioritised given there will be an opportunity cost to other dental services, a Benefit Trade-Off (BTO) exercise was conducted with members of the public in England (n=577). This exercise asked members of the public how many years of functioning dentition they would be willing to sacrifice in order to reduce the inequality in functioning dentition.

Results: The results from the BTO show that a third of the respondents believe that total oral health gain and inequality reduction are important, but over half of the sample are unwilling to sacrifice a gain in functioning dentition to reduce inequalities. An additional year of functioning dentition for the lowest socioeconomic group is worth 1.16 times more than for those in the highest socioeconomic group.

Implications: For dental contract and system reform of NHS dentistry, these results indicate that the focus should be on maximising oral health for the population.

30

Parental oral health knowledge and self-efficacy in improving oral health behaviours of primary school children 5-6yrs in Yaoundé, Cameroon.

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Abstract

Background: Early childhood caries (ECC) affects 60-90% of children worldwide and has extensive implications on their oral health as they grow into adulthood. Self-efficacy or parents' perception of their own ability to deliver the behaviour of regular toothbrushing can significantly impact children's oral health. Our study aimed to assess parental oral health knowledge and self-efficacy in improving children's oral health-related behaviours.

Methods: A mixed-method longitudinal prospective cohort study with children aged 5-6 years old and their parents was conducted at three primary schools in Cameroon. Children received a dental screening, oral health education, and supervised tooth brushing training using plaque-disclosing tablets. Parental self-efficacy and oral health knowledge were assessed using self-reported questionnaires. Intervention evaluation was through interviews with parents, teachers, and dentists.

Results: Among 112 children screened, the caries prevalence was 64.2% with a dmft index of 2.38. Of 91 responding parents, self-efficacy was low, and only a few supervise their children's tooth brushing habits. However, most parents had a positive attitude towards oral health.

Discussion: While causes of tooth decay were well-known to many parents, they often neglected their children's tooth-brushing habits. Although parents generally have confidence in their ability to meet their children's needs, factors such as parental depression, stress, anxiety, and child's temperament contribute to low parental self-efficacy. Providing access to training on parenting and enabling a supportive environment can improve parents' self-efficacy in improving children's oral health. Parents' ability to model good oral health behaviours and not just knowledge, impacts children's oral health habits.

31

The spatial dispersion of infectious virus in a multi organism model of dental bioaerosols

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Abstract

Background

Aerosols produced by dental instruments disperse oral microbes posing risk of infection. This experimental study used two bacteriophage tracers to measure dispersion of viruses during dental procedures.

Methods

Non-enveloped MS2 ($1.3x10^{10}$ plaque-forming units [PFU]/mL) and enveloped phi6 ($3.1x10^{10}$ PFU/mL) bacteriophages were infused into a dental mannequin's mouth whilst an air-turbine dental handpiece was used. Each replicate (n=4) used two optical particle counters (OPCs) to measure aerosol concentration, and virus was captured in 65 surface samples and 4 air samples across a $50.3m^2$ area. Plaque assays measured infectious virus and reverse-transcription polymerase chain reaction (RT-qPCR) measured viral RNA. Non-linear regression was used to explore virus recovery.

Results

OPC aerosol concentration was greatest at 1m, with ~100-fold spikes during the procedure. Infectious virus recovery reduced with increasing distance, and an average of 2,147 PFU/cm^2 was recovered from surfaces at 0.5m for MS2 and 5.3 PFU/cm^2 for phi6. Very little infectious virus was recovered from surfaces beyond 1m, although viral RNA was detectable at greater distances. Recovery of both viruses was similar in air samples at 0.5m, MS2: $1.2x10^5$ PFU/m^3; phi6: $1.0x10^5$ PFU/m^3; this reduced approximately 10-fold at 4m.

Conclusion

Infectious virus was dispersed from the mouth during dental procedures. On surfaces, the highest viral load was present within 1m, but the amount of recovered virus and transmitted distance was greater in air samples, which unmitigated, poses an infection risk to staff and patients. Recovery was dependent on the virus, demonstrating the importance of surrogate virus selection in simulation studies.

32

Quantitative and Automated analysis of Head and Neck Cancers using Artificial Intelligence

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Abstract

Background: Artificial Intelligence (AI) has been shown to help in the identification and quantification of digital tissue biomarkers in several cancers.

Purpose: To determine whether morphometric analysis using a custom-trained classifier is useful in the objective assessment of clinicopathological, molecular, mutational, and survival correlation in HNSCC.

Methods: The retrospective study used whole slide images (WSI) of HNSCC from the publicly available datasets and an AI-based open-source software for image analysis. In the morphometric study, epithelial, stromal, and immune cells in WSI of normal oral mucosa (NOM), dysplasia (OED), and HNSCC were annotated, followed by morphological features extraction and comparison using ANOVA and Student t-test. For classifier development, two classifiers, artificial neural network (ANN-MLP) and Random trees (Rtrees) were trained with epithelium, stroma, immune cells, and mitotic figures in WSI of NOM, OED, and HNSCC WSIs.

Results: Student t-test and ANOVA revealed statistically significant differences between most morphological features of epithelial, stromal, and immune cells between NOM, OED, and HNSCC ($p<0.05$). The ANN-MLP classifier performed better than Rtrees for automatic segmentation of epithelium, stromal, and immune cells, with F1 scores of 0.78, 0.79, and 0.82 respectively. The downstream analysis showed a significant correlation between morphological features and prognosis in HNSCC. The F1 score of the ANN-MLP classifier for atypical mitosis was 0.79 and both, automatic and manual counts were significantly correlated with prognosis in HNSCC.

Conclusion: Morphometric assessment using a custom-trained classifier can potentially serve as a tissue biomarker for objective differentiation between dysplasia and cancer, prognosis determination, and risk stratification.

33

Beyond the Oral Microbiome: Investigating the oral ecosystem and disease development.

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Abstract

Background

A diverse range of organisms form communities within the oral cavity, composing the oral microbiome. This is becoming increasingly associated with oral and systemic disease development. Current understanding of oral and oropharyngeal ecology is majorly based on traditional methods that rely on culturability or are limited to identifying known bacterial species (16S rRNA sequencing). The shotgun metagenomics (SM) approach gives a more representative snapshot of microbiome composition by identifying often overlooked fungal, viral, and novel populations.

Aim

Creating and utilising existing databases and clinical datasets to develop a reproducible toolkit that can be used to investigate the roles of oral microbiome components in health and disease.

Methodology

Public genomic and transcriptomic datasets related to oral health and microbiome will be interrogated further. Intuitive analysis pipelines and standard protocols will be developed for and validated by the investigation of oral cavity and oropharyngeal samples (e.g., ongoing tonsillitis study). This bioinformatic toolkit will be employed to study the role of oral microbiome members in the development of oral and

systemic disease in current and future research. This study will contribute to the vast 16S rRNA data generated by the Oral Sciences Research Group and an ongoing Haleon project.

Expected Results

By employing SM and the toolkit, the inter-species dynamics present in oral microbiomes can be studied to help identify diagnostic and prognostic predictors of oral/systemic health and disease. SM could also elucidate factors beyond the microbiome, e.g., antimicrobial resistance genes, that influence disease pathology, potentially suggesting new therapeutic approaches.

34

Association between oral health literacy and dental attendance among socially excluded people in East of Scotland

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Abstract

Background

Health literacy includes the abilities to understand health information to make decisions and take actions to maintain good health. Poor oral health literacy (OHL) are prevalent globally, especially among socially excluded groups, which is associated with poor oral health. Improving OHL was suggested as essential to reducing oral health disparities. The study aims to explore the association between OHL and dental attendance among socially excluded people in East Scotland.

Method

A cross-sectional survey was conducted using convenience sampling. Adults who attended third sectors in Dundee and had dental visits in Scotland were recruited. OHL was assessed by HeLD-14 and dental attendance were measured using Adult Dental Health Survey questionnaire. Descriptive analysis, Chi-square test, and logistic regression were applied.

Findings

A sample of 402 participants participated with 52% being male, 68% being single, 57.4% living in the most deprived area, and 63.4% native English speakers. The mean of HeLD-14 was 36.27 and low OHL (<36) was seen in 46.3% of participants. Younger participants were significantly more likely to register with a dentist and for preventive reasons. Participants from less deprived areas were more likely to visit the dentist regularly than those from the most deprived areas. The influence of language significantly shaped dental attendance patterns. There were significant positive relationships between oral health literacy and patterns of dental attendance ($P<0.01$).

Conclusion

Almost half of participants had low OHL. Participants with lower OHL are more likely to report unfavourable patterns of dental attendance.

35

Innovative Bioactive Glass-Ionomer Cement Variants for Dental Applications

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Abstract

Objectives

To improve properties of a newly developed glass-ionomer cement (GIC) through modification with a sodium-free bioactive glass (BAG) for enhanced mechanical strength, antibacterial activity, and mineralization.

Methods

Ion-substituted fluoro-aluminosilicate glass (LG99Sr-Mg-Zn) based on $4.5SiO_2$-$3Al_2O_3$-$1.5P_2O_5$-$3SrF_2$-0.5SrO-1MgO-0.5ZnO and a new BAG composition ($38.3SiO_2$-$6P_2O_5$-43.9CaO-$6.8CaF_2$-5MgO) was synthesized by the melt-quench technique and thereafter characterized. The LG99Sr-Mg-Zn glass and reference GIC, Fuji IX GP (GC Corporation, Tokyo, Japan) were modified by varying BAG concentrations (5%, 10%, 15%). Compressive & flexural strength, Vickers microhardness and setting time (ST) of the cements were determined at 24 hours and one month in accordance with ISO-specifications. Mineralization studies, ICP-OES and antibacterial tests were also performed. Statistical analysis was done using two-way ANOVA and Tukey's tests, significance level at 0.05.

Results

LG99Sr-Mg-Zn and Fuji IX containing 5 and 10% BAG respectively, showed significant increases ($p<0.05$) in compressive & flexural strength and hardness properties, which further increased after maturation. However, modification with 15% BAG significantly decreased ($p<0.05$) these properties and extended ST. ICP-OES showed release of magnesium and zinc from LG99Sr-Mg-Zn containing 5% BAG and this improved **antibacterial activity**. Apatite-like layer formation was observed on the surface of BAG-containing GIC groups and appeared to be related to BAG concentration and immersion time in tris buffer solution and simulated body fluid.

Conclusion

The addition of 5% and 10% sodium-free BAG optimized mechanical, antibacterial, and mineralization properties of LG99Sr-Mg-Zn and Fuji GICs, suggesting their potential for restorative use.

36

Surface properties of CAD/CAM composites after using different chair-side polishing protocols before and after adjustments.

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Abstract

Objectives

To evaluate surface roughness and gloss of two CAD/CAM composite materials after polishing with chair-side polishing protocols before/after surface adjustments.

Methods

Ten samples (13.5mmX11mmX3mm) for each of Brilliant-Crios (Coltene) and Tetric-CAD (Ivoclar) composites were sectioned with a diamond-wire saw and divided into two groups (n=5); Group 1: 5-step polishing protocol by Soflex-discs, followed by a polishing paste and Enhance-cup for 30s for each step; Group 2: One-step polishing protocol by Kenda-Maximus for 30s with water-irrigation. Surface roughness-Sa was measured using white-light profilometry. Surface gloss was evaluated using a Novogloss-glossmeter at stages:(1) baseline, (2) polishing (3) after surface adjustment with yellow-band finishing bur, and (4) repolishing after adjustment.

Results

Surface roughness at the four stages for Brilliant-Crios 5-step samples was 0.50±0.04µm; 0.31±0.04µm; 2.67±0.52µm and 0.63±0.19µm, respectively and for one-step samples: 0.43±0.07µm; 0.44±0.07µm; 2.18±0.36µm and 2.06±0.35µm.

For Tetric-CAD 5-step samples: 0.51±0.10µm; 0.35±0.11µm; 2.03±0.26µm and 0.54±0.16µm, and 0.48±0.04µm; 0.45±0.05 µm; 2.12± 0.26µm and 1.88± 0.22µm for the one-step samples.

Gloss for Brilliant-Crios 5-step samples was 10.87±0.94GU; 25.59±0.43GU; 10.72±0.50GU, and 28.76±1.15GU and for one-step samples was 11.49±0.77GU; 20.61±2.57GU; 10.42±0.47GU and 25.56±3.62GU.

For Tetric-CAD 5-step samples, gloss was 9.59±0.26GU; 26.57±4.84GU; 9.90±0.79GU, and 26.46±0.80GU, and 10.30±1.02 GU; 15.54±1.18 GU; 9.45±0.41 GU and 25.91±2.34GU for the one-step samples.

Conclusion

The universal 5-step protocol produced superior results for polishing CAD/CAM composites than the one-step protocol, considering the surface adjustments used in this study. Although the Brilliant-Crios is smoother and glossier than the Tetric-CAD at stage-2, Tetric-CAD seems to have a highly smoother and glossier surface after stage-4.

37

Three-dimensional investigation of a novel radiopaque infiltrant on natural enamel carious lesions

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Abstract

Objectives: To assess the shape and depth of a novel radiopaque infiltrant in 3-dimensions as a non-invasive method to manage early natural enamel carious lesions. **Methods:** Five permanent molars with natural non-cavitated proximal carious lesions (ICDAS score 2) were selected and imaged initially using high-definition X-ray Microtomography (XMT, MuCAT2, QMUL). A novel radiopaque resin with low viscosity was applied to the lesions' surface without removal of the 'hypermineralised' surface, and light-polymerised. Then the teeth were rescanned and the images were aligned. The 3D shape and depth of penetration of the radiopaque infiltrant in the lesion was visualized and analysed using Drishti software. **Results:** The 3D reconstruction demonstrated that the enamel lesions were cone shaped, with a surface layer thickness of 50 ± 30µm, and the lesion body exhibiting linear-attenuation-coefficients (LAC) of 2.2 (± 0.5) and 1.7 (± 0.3) cm^{-1}, respectively. The LAC of normal enamel ranged from 2.7 to 3.1 cm^{-1}. After infiltration, the resin, with a LAC of 3.41 cm^{-1}, predominantly resided on the surface, effectively sealing the surface layer. However, in areas with surface defects, the infiltrant penetrated into the lesion. **Conclusion**: The novel resin has a high radiopacity, distinguishable from normal and carious enamel including the surface layer. Although the surface layer prevents the resin from penetrating into the lesion body, the resin appears to seal the surface completely, with a low viscosity enough to infiltrate through the surface imperfections. Thus, this novel radiopaque resin can seal and infiltrate early carious lesions while allowing for radiographic monitoring of its integrity.

38

Airborne particles Characteristics and Microbiological Contamination of Dental Operatories: A Critical Review Abdulrhaman Almutairi, Charles Mein, Ben Jones, Shakeel Shahdad, Noha Seoudi

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Abstract

Background: In dental settings, airborne particles generated during the different dental procedures can transmit infections. This study aimed at reviewing and critically appraising studies conducted to identify the airborne particles characteristic and microbiological contamination in dental operatory.

Methods: Systematic literature search was conducted on multiple scientific databases such as PubMed, MEDLINE, Science Direct, and Google Scholar, complemented by manual reference checks. Rigorous inclusion and exclusion criteria are applied to select studies from 1993 to 2023. Identified studies were critically appraised by Joanna Briggs critical appraisal tools. Subsequently, data were extracted systematically to answer the research question.

Results: Out of 2620 articles, six systematic reviews on airborne particles characteristics and 31 primary studies on microbiological contamination were included. Airborne particles identified was variable in size from 1 µm to 100 µm. The main area for detecting these particles was 2 meters around the patient for variable period of time mostly reported as 40 minutes. However, microbial contamination was also identified up to 4 meters around patient. Many microorganisms were identified such as Enterococcus faecalis, Streptococcus species, Staphylococcus; Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Mycobacterium tuberculosis; and Candida spp.

Conclusions: This review reveals that airborne particles in dental settings can significantly contaminate two meters radius around the patient (directly zone) with oral microflora and oral pathogens. However, area outside the dirty zone can still be contaminated with pathogenic microorganisms and should not be neglected during the routine dental operatory decontamination to ensure breaking the chain of infection transmission.

40

Understanding tissue interactions during TMJ development and homeostasis

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Abstract

The temporomandibular joint (TMJ) is one of the most used joints in the body. It is formed between the condylar process of the mandible (or dentary bone) of the lower jaw, and the glenoid (or mandibular) fossa of the squamous portion of the temporal bone in the upper jaw. Embryonic defects in the condyle in mice have been shown to have a secondary impact on the shape and development of the glenoid fossa, highlighting the importance of interactions that coordinate development of the two sides of the joint. Although condylar cartilage formation has been studied in detail, much less is known about development and homeostasis of the glenoid fossa. Here we have analysed the origin and genetic identify of the glenoid fossa utilising transgenic mouse model. Using 3D reconstructions and immunofluorescence staining, we show that the glenoid fossa matures postnatally with creation of a fibrocartilaginous layer, which is distinct molecularly from the fibrocartilage on the condyle. Loss of fibrocartilage on the condyle in a *Fsp1cre;DTA* mouse line, leads to pronounced defects in TMJ morphology and structure with remodelling of the fossa. In addition to shape changes, the TMJ displays changes in extracellular matrix (ECM) deposition, mimicking changes observed in osteoarthritis. These mice, therefore, provide a novel model for studying osteoarthritis in the TMJ.

41

Understanding of the complex interaction between AMPs and the oral microbiome

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Abstract

The oral cavity hosts approximately 700 species of bacteria that interact with each other both physically and metabolically, and some of these bacteria are key contributors to periodontitis. Furthermore, cigarette smoking is a major risk factor for the onset and progression of periodontitis. The first line of defense in the oral cavity are antimicrobial peptides (AMPs), which play a bridging role between innate immunity and acquired immunity, and have a wide range of antimicrobial activity against both Gram-positive and Gram-negative bacteria, viruses, and fungi. One of these AMPs is LL-37, which is produced by gingival epithelial cells and defence cells such as macrophages and neutrophils. LL-37 is more resistant to enzymatic degradation than other antimicrobial peptides because it can form dimeric and trimeric clusters in solution. The concentration of LL-37 is known to increase in periodontitis. This study evaluated the anti-biofilm activity of three LL-37 derivatives against single-species and multiple-species oral biofilms of *Fusobacterium nucleatum* and *Porphyromonas gingivalis.* The influence of cigarette smoke extract on the anti-biofilm properties of AMPs is also reported. The results of this study can help to identify AMP derivatives that are effective against pathogenic oral biofilms and to understand whether this effectiveness may be hampered in smokers.

42

Using the consolidated framework of implementation research to consider the use of silver diamine fluoride in NHS primary dental care.

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Abstract

Introduction

Dental caries in young children is common with 23.7% of 5-year-olds affected. Silver diamine fluoride (SDF) is non-invasive approach to managing caries, but its use in NHS service provision is limited. This study adopted a theoretical approach to explore its implementation in practice.

Methods

Semi-structured qualitative interviews were undertaken with dental staff (n=19) and key policy-makers (n=7). Interviews and analysis were informed by the consolidated framework of implementation research (CFIR), which determines local, system and policy level influences to adoption. Data were analysed using deductive and inductive coding.

Results

Implementation of SDF in NHS service provision appeared to be influenced by the following CFIR constructs:

- Innovation domain of SDF: the evidence base, its contribution to quality care, relative advantage, adaptability and complexity of the clinical protocol and cost;
- Outer setting: the needs of patients and parents, peer pressure and contextual factors such as policies and contractual requirements;
- Inner setting: structural characteristics and available resource, networks and communication, culture, compatibility, relative priority, tension for change, readiness for implementation, leadership engagement and access to knowledge and information;
- Individuals involved: self-efficacy, knowledge and belief about SDF, their stage of change related to SDF implementation and role within the organisation;
- Process of implementing SDF: assessing needs, engaging patients, parents and professionals, planning, delivering the clinical protocol, reflecting and evaluating.

Variation in the operationalisation of the CFIR constructs was seen at local, system and policy level. Those working within a practice environment reported higher levels of confidence in their ability to

adopt SDF, although contractual arrangements were a barrier. Stakeholders at regional and national levels prioritised social inequalities whereas the culture in practice was more focussed on individual patient need. Knowledge of the empirical effectiveness of SDF was varied.

Conclusion

Implementation of SDF is affected by multiple constructs at local, system and policy level.

43

A potential dentine desensitising agent using vaterite.

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Abstract

Background and purpose

Dentine hypersensitivity (DH) is a common oral condition and current treatment approaches aim towards dentine tubule occlusion and remineralisation using bioactive glasses, calcium phosphates or use varnishes of sodium fluoride, potassium nitrate, silver diamine fluoride and arginine prophylaxis solutions or pastes. This study reports the formulation of a DH agent comprising of vaterite, the most unstable form of calcium carbonate, with a polymerisable self-etching monomer that can potentially localise particles within the tubules and enable long-term tubule occlusion.

Methods

The DH agent was formulated with bis[2-(methacryloyloxy) ethyl] phosphate (BMEP) as a self-etching functional monomer, 2hydroxyethyl methacrylate (HEMA), ethanol-water and vaterite with photoinitiators. The interaction of the photopolymerised DH agent with SBF at 37ºC was analysed using FTIR. Dentine discs with exposed tubules were treated with the DH agent using a microbrush. The occlusion of dentinal tubules was imaged using SEM and dentine permeability under simulated pulpal pressure evaluated before and after treatment.

Results and Discussion

The FTIR spectra of the DH agent on interaction with SBF indicated the persistence of vaterite 745 cm^{-1} (ν_4CO_3) over 30 days, with new peaks arising at 874cm^{-1} $\nu_2(CO_3)$, and 1652 cm^{-1}(-OH) due to hydration. The SEM images showed formation of plate-like particles within the dentinal tubules associated with phase transformation of vaterite, whilst dentine permeability supported the findings.

Conclusions

The DH agent acted as a vaterite carrier that were localised within dentinal tubules which could be beneficial for further remineralisation and effective in management of dentine hypersensitivity.

44

Comparison of the internal fit of 3D printed Resin Crowns with Milled and Pressed Ceramic Crowns

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Abstract

Objective: The aim of this study was to compare the internal fit accuracy of crowns constructed using three different manufacturing methods: 3D printed, milled, and pressed.

Methods: 5 3D printed resin crowns (Temporary Resin Bio, Taglus, India and Planmeca Creo C5, Planmeca, Finland), 5 milled ceramic crowns (e.max.CAD, Ivoclar Vivadent, Liechtenstein and Planmeca PlanMill 50, Planmeca, Finland) and 5 pressed ceramic (e.max.press, Ivoclar Vivadent, Liechtenstein) were manufactured from an .stl file designed using CAD/CAM software (ExoCAD, Germany). 15 dies were printed (Planmeca Creo C5, Planmeca, Finland). All crowns were cemented to the dies using a self-etching adhesive resin cement (RelyX Unicem, 3M). Following cementation, the central 1mm of the crowns were sectioned with a diamond wafering blade in the bucco-palatal axis (IsoMet, Buehler, Germany) and the cement space was measured using a digital microscope (Keyence VXF Digital Microscope). The mean (SD) cement gap thickness (µm) occlusally and axially was measured and the statistical level was set to $P<0.05$.

Results: The accuracy of occlusal fit of the 3D printed, milled, and pressed crowns showed no significant differences ($p>0.05$), with 219 (12.2) µm, 233.2 (26.9) µm, 214.6 (32.9) µm respectively. In contrast, axially a statistically significant improvement of fit was found for 3D printed vs. milled and pressed crowns, with 81.7 (31.0) µm vs. 177.4 (25.3) µm and 183.1 (34.5) µm respectively ($p<0.05$).

Discussion: The accuracy of fit varied from the occlusal to the axial surfaces. The 3D printed resin crowns showed accuracy of fit closest to clinically ideal values however further research is needed to understand design and manufacturing parameters affecting the fit of 3D printed restorations.

Conclusion: The axial fit of 3D printed resin crowns was more accurate than pressed and milled ceramic crowns in this study however there were no differences to the occlusal surfaces.

47

Detection of Previously Undiagnosed Atrial Fibrillation in Dental Clinics

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Abstract

Objectives: Periodontitis is associated with cardiovascular disease (CVD) and growing evidence suggests an association between severe periodontitis and stroke mediated by atrial fibrillation (AF). AF is prevalent affecting ~2 million people in the UK and can increase risk of ischaemic stroke 5-7-fold compared to the general population. The detection rate of new cases of AF is 1.44% in patients >65 years old in screening settings. AF can be effectively managed with anticoagulants, greatly reducing stroke risk. Currently, AF screening is not routinely conducted in dental settings. This study aimed to undertake screening for AF in patients attending a dental hospital in Northeast England, and also investigate correlations between periodontal status and AF incidence.

Methods: Patients aged 65 years and over attending Newcastle Dental Hospital had their heart rhythm monitored using KardiaMobile. Patients with an abnormal rhythm (possibly indicating AF) were referred to their GP for further assessment and medical management as appropriate.

Results: 635 dental patients were screened over 12-months period. 58% (n=368) were female. 58.9% (n=374) were aged 65-74 years. 1.5% (9 patients) were identified with previously undiagnosed AF, and one was subsequently hospitalised and was subsequently prescribed anticoagulants. 47.7% (n=303) had a periodontal status recorded in the notes. No significant relationship was found between periodontal status (historic BPE data) and AF incidence (chi square p=0.442).

Conclusions: Screening for AF in a dental hospital setting has potential to offer a significant public health intervention and improve the cardiology outcomes for patients by identifying undiagnosed AF.

48

“All I had to do was open my mouth wide”- a qualitative exploration of the acceptability of photobiomodulation for oral mucositis prevention in children with cancer, their parents, and healthcare teams.

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Abstract

BACKGROUND: Eight in every ten children and young people (CYP) receiving cancer treatment develop oral mucositis. Photobiomodulation is recommended for prevention of oral mucositis in international paediatric oncology guidance, however, the acceptability to CYP and healthcare professionals (HCPs) has not been explored.

METHOD: Participants were purposively sampled, aiming for diversity in age, cancer diagnosis (CYP), professional role (HCPs) and photobiomodulation experience (all groups). Semi-structured interviews with CYP/parent dyads and focus groups with HCPs were audio recorded, and professionally transcribed. Data were coded to the Theoretical Framework of Acceptability and qualitative summaries generated, with comparison occurring within and between participant groups. Subthemes and over-arching themes were inductively developed and refined through discussion. Recruitment occurred alongside analysis until repetition of data and an absence of novel themes.

RESULTS: Twenty-seven participants were interviewed (eight CYP, ten parents, nine HCPs). CYP were aged 8-15 years old, with experience of six distinct cancer diagnoses. HCPs had diverse professional roles within paediatric oncology and paediatric dentistry. Most participants, 55% (n=5) of families and 78% (n=7) of HCPs, had received and delivered photobiomodulation respectively. Four themes were generated: (1) Positive perspectives on photobiomodulation; (2) Importance of child-centredness and autonomy; (3) Lack of understanding of photobiomodulation treatment; (4) Perceived additional burden to healthcare teams.

CONCLUSION: Photobiomodulation for oral mucositis prevention is acceptable to CYP, their parents, and HCPs during cancer treatment. Photobiomodulation services should be designed to reduce burden on healthcare services, with resources developed to support CYP autonomy, comprehension, and acceptability of photobiomodulation treatment.

49

Characterising Changes in Enamel Surface Crystallite Organisation and the Development of Sub-surface Porosity Following Dietary Acid Erosion

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Abstract

Objective:
We examined surface structural and porosity changes to human dental enamel surfaces following simulated dietary erosion to inform preventative/remineralisation technologies. Polarisation-induced-contrast X-ray fluorescence (PIC-XRF) at the Calcium K-edge was developed as a novel method to quantify hydroxyapatite (HaP) surface crystallite orientations and texture following erosion. Sub-surface enamel porosity was quantified using gold nanoparticle labelling combined with micro-XRF and imaging mass spectrometry (LA-ICP-MS) techniques.

Methods:
Mid-buccal, caries-free enamel (n=3) was epoxy-embedded, sectioned, polished, lasered with fiducials and interrogated using a high brilliance 2µm beam footprint, linearly polarised, monochromatic X-ray source. Samples were rotated through 0°-175° relative to the polarisation vector and mapped at 2 energies identified corresponding to key electron transitions in Ca (1s to 4p3/2 and 1s to 4p1/2). After five minutes erosion in 0.3% citric acid (pH 2.7), surfaces were remeasured. Data analyses included sine-function fitting and regression analyses. Additional acid-eroded enamel samples were exposed to gold-coated magnetic nanoparticles (20nm, 40nm, 100nm, 250nm) under a 133.6mT magnetic force to draw nanoparticles through the pore spaces. Micro-XRF and LA-ICP-MS were used to identify depth and spatial variance in nanoparticle penetration.

Results:
PIC-XRF measurements at 4049.2 and 5051.1 eV and varying angles relative to the polarisation plane facilitated composite image construction of primary and secondary HaP orientations in human enamel and associated texture. Notable contrast enhancements seen post-erosion indicated selective dissolution of certain orientation of HaP crystallites and loss of the original texture. XRF and LA-ICP-MS quantitatively assessed subsurface porosity which showed significant variance to a depth of ~20µm.

Conclusion:

We successfully characterised how the sub-prismatic structure of enamel influences dissolution patterns and the development of sub-surface porosity using novel methods. These measurable changes to the

surface and sub-surface likely impact enamel's mechanical properties and material penetration into the sub-surface, both crucial for effective remineralisation techniques.

50

Controlled drug release electrospun patches for prevention of alveolar osteitis

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Abstract

Third molar extraction, a common surgical procedure, is notorious for postoperative complications with one in six patients experiencing alveolar osteitis (AO). AO is characterised by loss of the blood clot from the tooth extraction socket leading to infection and pain, which often results in repeated hospital visits, imposing a substantial time and financial burden on healthcare systems.

To address this, a novel AO preventative measure was designed and fabricated in the form of a drug loaded mucoadhesive patch composed of dual electrospun polyvinyl pyrrolidone (PVP)/ Eudragit-RS100 and poly-N-isopropylacrylamide (PNIPAM) fibres that are protected by a hydrophobic poly(ε-caprolactone) (PCL) backing layer. These patches demonstrated rapid release of prednisolone along with prolonged and controlled release of bupivacaine, while maintaining the pharmacological functionality of these drugs. Tissue engineered gingival mucosal equivalents (GME) displaying a well differentiated, stratified squamous epithelium on top of a fibroblast populated lamina propria was used as a test platform. Upon topical application of the patches to GME both prednisolone and bupivacaine were released from the fibres and permeated through the tissue in a time dependent manner, showing that these patches can deliver drugs to tissues effectively.

Taken together, these data show that dual electrospun patches have the potential to provide a mucoadhesive covering to prevent blood clot loss while delivering pain relief and anti-inflammatory therapeutics to tooth extraction sites to prevent AO. This study not only offers a future clinical avenue for the prevention of AO but also contributes valuable insights into future advancements in periodontal and local drug delivery research.

51

Guardian of Grins: Investigating the Biocompatible Properties of Nano Silver-Hydroxyapatite Coatings on Gingiva Cells.

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Abstract

Peri-implantitis is a prevalent inflammatory disease caused by biofilm attachment on dental implants causing bone loss and eventual implant failure. Due to rising anti-biotic resistance, an alternative therapy involving coating nano-silver on titanium implants has been researched with successful antimicrobial effects. A balance needs to be found to ensure silver nanoparticles impart a cytotoxic effect on bacteria without compromising surrounding tissues. Nano-hydroxyapatite is a natural substance known to improve osseointegration and increase biocompatibility when incorporated on dental fixtures. This study aims to investigate the biocompatibility of nano-silver-hydroxyapatite (Ag+nHA) composites with cells of the oral gingiva *in vitro*. Objectives included seeding human gingival fibroblast cells on the composites and allowing a 7-day incubation. Fibroblasts were assessed for markers of stress using bioassays to assess cell viability, lactate dehydrogenase leakage and collagen production. Morphology of the cells was inspected using Scanning Electron Microscopy and ICP-OES was used to investigate silver dissolution. Cells cultured on Ag+nHA specimens adhered well to the composite, showed good confluence and healthy filopodia, compared to sparsely covered on the Ag specimen. The fibroblasts fared better on Ag+nHA than on Ag alone as seen by the higher cell viability (75%), negligible LDH leak (0.035 µmol/min/ml) and superior collagen production (18 µg). An Ag^+ release range of 1.15-7.64 mg/L was seen in the external media, meeting the 3.125 mg/L cytotoxic threshold against *Streptococcus mutans.* The evidence of healthy, confluent cells indicates that Ag+nHA composites provide an ideal biocompatible environment for wound healing which is supported by low stress levels and ability to carry out functional collagen production. Therefore, Ag+nHA composite offers both antimicrobial and biocompatibility properties and should be considered as a potential preventative biomaterial.

52

25(OH) vitamin D – a prognostic biomarker of apical periodontitis

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Abstract

Objectives: To investigate the changes in serum 25(OH)vitD level after endodontic treatment in apical periodontitis (AP) subjects with or without metabolic syndrome (MetS). The associations between serum 25(OH)vitD levels and MetS indicators, lipid-profiles, and other clinical parameters were also assessed.

Materials and Methods: AP subjects with or without MetS (MetS n=33; non-MetS n=63) were recruited at Guy's Hospital Dental Institute and were reviewed at 6 months and 1 year post-treatment. Serum levels of 25(OH)vitD were detected using Human 25(OH) Vitamin D ELISA kits and lipid-profiles with CardioCheck-PA analyzer. Statistical analyses were performed to compare 25(OH)vitD levels among different groups and timepoints, and to determine the correlations between 25(OH)vitD levels and other parameters.

Results: Baseline 25(OH)vitD levels in MetS group were significantly lower than those in non-MetS group ($p=0.046$, Mann-Whitney). Longitudinally, for MetS group, 25(OH)vitD levels were significantly higher at 6-month review compared to baseline ($p=0.0001$, Wilcoxon). As for non-MetS group, 25(OH)vitD increased significantly from baseline to 6-month review ($p<0.0001$, mixed-effects analysis) and then decreased at 1-year review ($p=0.0458$, mixed-effects analysis). In MetS group, a significant negative correlation was detected between 25(OH)vitD level and triglyceride at 6-month review (rho=-0.64, $p=0.002$). Whilst in non-MetS group, a significant negative correlation was found between baseline 25(OH)vitD level and systolic pressure (rho=-0.46, $p=0.0003$), and a significant positive correlation was found between 1-year 25(OH)vitD level and age (rho=0.33, $p=0.042$).

Conclusions: MetS group had significantly lower baseline 25(OH)vitD levels compared to non-MetS group. Both groups experienced significant rises in 25(OH)vitD levels at 6-month review. 25(OH)vitD level was associated with MetS indicators. Overall, 25(OH)vitD can be considered a potential biomarker for the prognosis of AP.

53

Unravelling the roles of Runx2 in tooth development and replacement

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Abstract

Tooth initiation is a complex process. The reciprocal interaction between epithelium and mesenchyme is crucial for this process, which is conducted by many signaling pathways, such as Wnt, shh and Bmp signaling pathway which also contribute to tooth eruption and replacement.

Runx2, a transcriptional factor, plays important role in tooth formation. Tooth failed to develop beyond the bud stage in the Runx2 knockout mice. The expression of Runx2 is specific in tooth in different timepoint. The relationship between the Runx2 and other signaling pathways during the tooth development needs to be elucidated. In this project we are going to investigate the role of Runx2 in tooth development in relationship with other signaling pathways in a more controlled manner.

We found Runx2 is expressed in both odontogenic epithelium and mesenchyme from early stage of tooth development in wildtype mice, and the epithelial expression of Runx2 can be found only in the labial side of the tooth organ. Conditional loss of Runx2 in the neural crest (Wn1creRunx2) hinders the development of molar and the molar in lower jaw is more affected than that in the upper jaw indicating different regulation of Runx2 in tooth development between the upper and lower molar. Tooth germ regress at the later stage constituted with several abnormal buds, corresponding to the abnormal expression of PCNA in the epithelium of tooth germ in mutant mice. The abnormal nuclear expression of Yap in epithelial cells in mutant mice indicating the mislocation of enamel knot. The expression of Lef1 which is used as a readout of Wnt signaling pathway is not affected in the Runx2 mutant mice. K14creRunx2 mutants, with an epithelial-specific loss of Runx2, didn't

exhibit obvious phenotype in tooth indicate the less important role of epithelial Runx2 expression in tooth development at embryonic stage.

54

Developing an Altered Eating scale: Relationships between eating experience and well-being.

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Abstract

Background: Chewing difficulties are associated with poor physical and mental well-being. These relationships could be explained by the impact poor chewing has on eating experience. The Altered Eating Framework (AEF) provides a biopsychosocial representation of eating across 7 domains (anatomical, functional, sensory, cognitive, behavioural, social, and emotional). To date, these domains have not been quantified or considered as potential influential factors when exploring the impact of chewing difficulty on well-being.
Aim: Quantitatively investigate relationships between chewing difficulty, pain, altered eating, and well-being.

Method: 179 participants completed an online survey assessing i) chewing difficulties and health, ii) pain, iii) altered eating experiences, and iv) well-being. Multiple regressions with follow-up mediation analysis were conducted for chewing difficulty, pain, eating experience, and well-being outcomes.

Results: Chewing difficulties were associated with poor well-being outcomes, this relationship was partially mediated by pain. The emotional AEF domain was most strongly associated with poor well-being, suggesting a possible hierarchical relationship between AEF domains.

Discussion: Findings highlight the importance of considering the holistic eating experience when exploring the impact of chewing difficulties on well-being. We propose the development of a comprehensive Altered Eating scale, extending the original framework to reflect 3 domains that are possible routes to altered eating (physical, psychological, environmental) and 5 domains that are impacted by altered eating (sensory, cognitive, behavioural, social, emotional). Quantification of these domains would allow for the creation of a visual map of eating experience, allowing patients and clinicians to easily identify areas of concerns and targets for intervention. Visual maps may also be useful for evaluating interventions, ensuring that the overall eating experience is improved rather than difficulty being transferred from one domain to another. Further, ability to quantify holistic eating experience may be beneficial for helping individuals self-manage their eating difficulties when accompanied by signposting to appropriate support resources.

55

Mucoadhesive Polymers Used for the Local Delivery of Antimicrobial Agents

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Abstract

Purpose: Mucoadhesive Polymers used for the local antimicrobial agents' delivery can potentially reduce systemic side effects and ensure sustained minimum inhibitory concentration, minimizing the potential for drug resistance. This study aims to identify the most suitable polymers for different antimicrobial agents.

Methodology: A systematic search of the literature was conducted on multiple scientific servers including PubMed, Scopus and Google Scholar. English language studies reported on drug release over time from mucoadhesive patches loaded with antimicrobial agents were included. Similar studies used drug delivery systems loaded with steroids and non-steroidal anti-inflammatory were identified as controls. Data were extracted systematically from all included studies and Joanna Briggs critical appraisal was conducted.

Results: Out of 480 studies identified, 64 fulfilled the inclusion criteria. A total of 26 different polymers were tested within them. Those were hydroxyethyl cellulose (HEC), chitosan, polyvinylpyrrolidone (PVP), gelatin, hydroxypropyl methylcellulose (HPMC), sodium alginate (GA), Carbopol, hydroxypropyl cellulose (HPC), polyvinyl alcohol (PVA), ethyl cellulose (EC), methacrylic acid (MAA), sodium carboxymethyl cellulose (NaCMC), guar gums, poloxamer 407, carboxyvinyl polymer, cubosomes (CUB), pectin, kappa-carrageenan, graphene oxide (GO), hyaluronic acid (HA), gum tragacanth, polymethylvinylether/maleic anhydride (PVM/MA), carbomer, polyethylene oxide (PO), xanthan gum (XG), dextran (DEX). Antimicrobial agents like polyene, azoles, nitroimidazole, fluoroquinolone, lincosamide, aminoglycoside, tetracycline, hydroxypyridone, macrolide and chlorhexidine were incorporated in different polymers in 35 different studies. The longest sustained drug release was 150hrs for macrolide from HPMC/HPC/MAA and the shortest was 2hrs for azoles from SA/PVA/DEX or AG/pectin.

Conclusion: The review provides insight for future researchers to select drug-releasing polymers.

56

Effect of Topical Treatment of SDF+Tannic acid and SDF+Glutathione on Demineralisation of Hydroxyapatite

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Abstract

Introduction: Studies have reported the combined use of silver diammine fluoride (SDF) with either tannic acid (TA) or glutathione (GT) to minimise the discoloration following SDF application.

Objectives: This study investigates the effect of these combined treatments on the demineralisation of HAp. Ion selective electrodes was used in this study to monitor Ca2+ release in real-time as a proxy for the extent of demineralization.

Methods: HAp discs (n=3 for each group) were demineralised for 4hrs using 0.1M acetic acid buffered to pH4.0. Thereafter, each disc was topically treated with SDF (Riva Star, SDI) followed by co-treatment with either aqueous TA or GT in concentrations of either 5%, 10% or 15% v/v. The topical application of SDF alone was used as control. The discs were then placed back into the demin solution for a further 4hrs. Calcium ion selective electrodes were used to monitor the ion concentrations in real-time at 1-min intervals. The percentage reduction of the rate of calcium loss (PRCL) was calculated, based on the rates of Ca^{2+} release before and after topical application.

Results: SDF only group demonstrated a PRCL of 65.96%. Co-treatment of SDF with 5%TA and 5%GT showed a PRCL of 79.94% and 82.83% respectively. SDF+10%TA and SDF+10%GT showed PRCL of 81.82% and 84.23% respectively. Increasing the concentration to 15% resulted in a drop in PRCL with SDF+15%TA and SDF+15%GT showing a PRCL of 74.67% and 70.35% respectively.

Conclusions: Co-treatment of SDF with TA or GT can improve the cariostatic properties of SDF by inhibiting calcium loss. SDF+10%GT provides highest reduction PRCL followed SDF+10%TA.

57

Arts and Science Interface-2: Sixth form student engagement in the co-design of theatre as a novel way to deliver oral health promotion/prevention in adolescents at-risk of caries from schools in underserved communities in areas of deprivation - the start of RAISED in Yorkshire

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Abstract

Health Need: ~45% of Yorkshire's 12-year-olds have dental decay correlated with deprivation and health inequality. Whilst largely preventable, reaching vulnerable adolescents is challenging.

Aim:

To demonstrate the value of theatre for Oral Health(OH) promotion/prevention.

Objectives:

To understand the value of theatre in:

1)increasing awareness/knowledge about OH promotion in adolescents;

2)inspiring the legacy of co-creating RAISED in Yorkshire (RiY-Research Activity in Schools Evaluating Dental Health) a peer-to-peer community engagement OH promotion programme in Schools.

Methods:

The "Don't Smile" theatre production and debate was co-designed with sixth formers, theatre practitioners, and DenTCRU staff. It explored implications of poor OH, social isolation/wellbeing and NHS dental access. Year 9 students(13-14 years) were by form convenience divide into 2 groups, Group A saw the play and Group B did not. The impact of viewing the play was assessed via OH questionnaires Baseline, after (Group A), and 12 months post viewing in Groups A&B in both schools.

Interviews with sixth formers involved in the theatre was undertaken to explore their motivation to initiate the co-creation of RiY a peer-led, complex intervention following a Citizen Science Approach delivered in schools.

Results:

Year 9 students Group A(n=151) saw the play and Group B(n=147) Baseline questionnaire response rate was 77.1% and 65.2% across both schools. Our embedded OH message were understood by 100% audiences. One-year post-viewing saw statistically significant retention of knowledge. Audiences of vulnerable teenagers from areas of worst oral health inequalities rated the play excellent/ very good.

Conclusions:

Theatre was an effective way to disseminate OH knowledge, non-judgmentally, facilitating OH awareness debate; aiding retention of knowledge 1-year post-viewing. The legacy was the co-creation of RiY OH programme supporting vulnerable adolescents. Theatre art and science successfully addressed a community challenge generating significant engagement, muti-directional gain, and adolescent-centred research and practice improvement.

58

Detection and characterisation of lysogenic bacteriophage in canine oral bacterial genomes

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Abstract

Periodontal disease (PD) is a condition that features inflammation of the gingiva, bone, and periodontal ligament. PD is one of the most common conditions diagnosed in small animal veterinary practises. PD typically involves the accumulation of subgingival bacterial biofilms. Bacteriophages are viruses that infect bacteria, and prophage are bacteriophage genomes which integrate into the host genome. Prophage infection may play a key role in dynamics of microbial communities.

The aim of the study was to evaluate prophage infection in common bacterial species in the canine oral cavity and to find their possible effects on the microbiome. From reviewing the literature, 62 canine commensals and pathogens were selected. The 8184 assemblies were downloaded from Genbank. Viral contigs were identified using Phispy, and the resulting 9056 phage contigs were annotated with Pharokka.

On average, 40.5% of bacteria contained prophage. Bacteria most associated with health were the least likely to be infected at 30.2%. Antimicrobial-resistance (AMR) genes were present in 704 prophage, and related to 16 different drug classes. These AMR prophage infected 24.1% of the bacterial species. In conclusion, we have demonstrated that prophage have the potential to greatly impact the microbiome. Genes carried by prophage have the capability of influencing on the pathogenicity of the microbiome, influencing disease progression and treatment responses. A clinical study evaluating the phageome in canine periodontitis is underway and will examine bacteriophages ability to modulate the real microbiome. Therefore to fully understand the microbiome within health and disease it is also necessary to consider the phageome.

59

In the Nooks and Crannies – Biofilm Treatment for the Hard to Reach areas of a Denture: an in vitro study

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Abstract

Objectives: The aim of this study was to investigate the anti-biofilm and anti-microbial activity of a newly developed denture cleanser (DC) tablet in hard to reach places between the interdental spaces of dentures *in vitro*.

Methods: An 11-species biofilm model was grown in a sequential manner for 8-days on full palate-less dentures or denture sections. Following maturation, biofilms were treated on a daily basis for 7 days, with DC tablets dissolved in ddH_2O, for 3 or 15 mins, with or without physical debridement using a toothbrush. Untreated controls were used as appropriate controls. Post-treatment, biofilms were imaged at a macroscopic or microscopic level, using crystal violet (CV) or fluorescent dyes (SYTO-9 and propidium iodide; PI). Additional dentures were sonicated for microbiological outputs using the Miles and Misra cell counting methodology and live/dead quantitative PCR technique to determine total and viable counts.

Results: All DC treatments were effective in reducing biofilm biomass and/or viable cells present on the denture, when compared to untreated controls. Fluorescence microscopy and macroscopic assessment with CV revealed treatment was effective in removing biofilm on the tooth surface as well as within the interdental spaces (Nooks and Crannies) of the dentures. In unbrushed controls, remaining biomass was more apparent than combinational therapy of DC with brushing, whilst fluorescent staining showed the bioburden was largely non-viable, as evidenced by excessive staining with PI. Microbiological outputs highlighted a time-dependent killing effect of DC treatment, with 15 min treatment more effective (>2-log reduction) than the 3 min regime (~1-log reduction).

Conclusions: This *in vitro* study highlights the efficacy of DC treatment in reducing biofilm bioburden and overall viability. It ultimately emphasizes the need for appropriate denture sterilisation methods to be implemented by edentulous patients to ensure the maintenance of good oral health.

60

Maintaining undergraduate experience in Removable Prosthodontics

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Abstract

Introduction

The provision of removable prosthodontics is a fundamental requirement expected of new graduates. Whilst more adults are retaining some natural teeth into their advancing years, there may be increased numbers requiring partial dentures. Those still requiring complete dentures may become more complex. Dental schools must navigate the changing demographics to ensure undergraduate experience.

Aims

To identify trends in undergraduate teaching of removable prosthodontics over four years.

Methods

Two questionnaire-based studies were undertaken. The first in 2019 and the follow up study four years later. Ethical approval was granted by Newcastle University Ethics Committee and electronic questionnaires were sent to all UK Dental Schools inquiring about the number of procedures, teaching methods, level of supervision, materials used and methods of assessment relating to removable prosthodontics.

Results

Ten schools responded to the first study and fourteen to the second study. Eight schools reported difficulty recruiting complete denture cases in each survey. The reported average number of partial dentures per student in 2019 was 6 and 3 complete dentures. The question was amended in 2023 to expected thresholds, which were 4 partial dentures and 3 complete dentures. Most schools were utilising simulation to enhance student experience for both complete and partial dentures. The simulation used included analogue manikin experience and clinical observation videos.

Discussion

Previous studies have suggested a continued downward trend of availability of complete denture cases for undergraduate training provision. However, our study highlighted that the majority of dental schools were concerned about recruitment of complete denture cases and were employing strategies to ensure

continued experience for their students. Whilst the question changed slightly from average number of cases students completed to expected thresholds, the numbers reported were similar from 2019 to 2023 and to those recorded in previous studies, which is testimony to the efforts of the individual schools.

61

Choosing Wisely: Reducing unnecessary care in dental primary care

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Abstract

Objectives:

Healthcare systems globally are subject to demand pressures. Policymakers must make difficult choices about what to fund within limited budgets, therefore interventions provided must offer good value. One means of promoting high-quality care is by taking a 'Choosing Wisely' approach. Choosing Wisely encourages a dialogue between healthcare professionals and patients, involving both in a shared decision-making (SDM) process. The routine provision of six-monthly dental check-ups and scale and polishes (S&P) for adults are treatments with no evidence of clinical benefit. Using these two treatments as exemplar behaviours, this study explored the barriers and enablers to reducing unnecessary care in primary care dentistry.

Methods:

Semi-structured theoretically underpinned interviews and focus groups.

Results:

Interviews were conducted with patients (N=14, UK-wide), professionals (N=20, Scotland) and systems-level stakeholders (N=34, UK-wide).

Dentists fear change, are frustrated by funding models, and have 'fallen out of love' with NHS dentistry. Patients value information about clinical evidence, what their care options are, and the opportunity to discuss these. Mapping the interview findings identified potential strategies to reduce the provision of unnecessary care. Focus groups with patients and professionals facilitated co-designed interventions for feasibility testing.

Conclusions:

Multiple factors and complexities influence the reduction of the routine provision of six-monthly check-ups and S&Ps. Whilst similar factors influence both patients and professionals, subtle difference exists in how they view the reduction of these treatments. There is an opportunity to positively improve the system through increased communication, SDM and higher-quality conversations between professionals and patients, to reduce unnecessary treatment and promote high-quality clinically effective care.

62

Meet me where I am: Pathways to improving oral health in early childhood

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Abstract

Introduction

Improving oral health is a priority in global health policy and research. Dental caries is preventable and is the most prevalent disease worldwide, significantly affecting children. It has a linear relationship with poverty, impacting lower socio-economic groups the most. Patient and public involvement (PPI) aims to improve the quality, relevance, and appropriateness of research, to ensure it meets the needs and expectations of those affected. There is a paucity of evidence on how best to involve children as PPI partners, with none focussed on dentistry.

Aims

To explore how to involve children as PPI partners in research to explore pathways to improving oral health.

Methods

A family community engagement event was held with third sector organisations. Researchers discussed with children how best to involve them in research design, conduct and dissemination. Participants were invited to provide verbal or written responses which were placed on post-it notes and displayed on flipcharts. Thematic analysis was undertaken.

Results

Children reported a desire to be involved in research, and expressed preferences for creative methods including making videos, sports, art, and role-play. They suggested certificates, stationary, food and toys as reimbursement for their involvement. Some children drew pictures to portray their feelings and experiences, suggesting future methods for involvement.

Conclusion

Children wish for PPI involvement to be a ‘fun’ experience, and to be thanked in a way that is meaningful for them. These findings will inform future research exploring pathways to oral health in childhood, and the establishment of a children’s dental PPI group.

64

Green Tea Mouthwash for the management of Peri-Mucositis Analysis of Clinical Outcome Measure of a Randomised Controlled-Triple Blinded Clinical Trial

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Abstract

Objectives: To assess the treatment effects of green tea mouthwash (GTM) compared to chlorhexidine (CHX) on periodontal parameters around natural teeth and dental implant(s) in patients diagnosed with peri-implant mucositis.

Materials and Methods: Patients diagnosed with peri-implant mucositis from two outreach dental centres were recruited, received non-surgical periodontal treatment then randomly assigned into test group (GTM) or control group (CHX) by minimisation randomisation with allocation concealment. Modified plaque surfaces (MPS) and modified bleeding surfaces (MBS) percentages were blindly evaluated at baseline (BL), two weeks (2W), three, six, nine and twelve months around teeth and dental implant(s).

Results: Forty-one patients were included with 95% statistical power. No statistically significant difference between GTM and CHX groups in all measured time points for MPS and MBS was found ($p>0.05$). However, statistically significant improvement was detected after treatment in both groups ($p<0.001$). The median MPS around teeth was as follow: GTM=11.10 (2W) and 53.00 (BL); CHX=16.70 (2W) and 48.50 (BL). The median for MPS around implants was as follow: GTM=44.0 (BL) and 10.00 (2W); CHX=42.00 (BL) and 0 (2W). The median for MBS around teeth was as follow: GTM=20.80 (BL) and 0 (2W); CHX=16.85 (BL) and 2.0 (2W). While the median MBS around implants was as follow: GTM=50.00 (BL) and 0 (2W); CHX=48.00 (BL) and 0 (2W).

Conclusion: GTM is as effective as CHX in controlling the plaque and bleeding scores around teeth and dental implants when used as adjunct for the non-surgical periodontal treatment for the management of peri-implant mucositis.

Keywords: ***Green tea mouthwash, Camellia Sinensis, dental implant, chlorhexidine, peri-implant mucositis, treatment***

65

Elucidating the role of glycobiology at the oral host-pathogen interface

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Abstract

Oral microbiome dysbiosis is highly correlated with periodontal disease progression, affecting 700 million people globally. A hallmark of this is an expansion of the red complex, which includes *Tannerella forsythia* (Tf). Sialic acids (Sias) are terminal residues of glycoconjugates and can be used as a carbon source or removed to reveal adhesion epitopes. Sialidases belong to the Glycosyl Hydrolase 33 family of carbohydrate-active enzymes and hydrolyse glycosidic bonds between Sias and glycoconjugates. The genome of Tf contains two GH33 enzymes, one being the already characterised NanH, and the other BFO_0701. This project aims to understand the substrate range of NanH and BFO_0701, to further characterise how Tf utilises and alters the Sia landscape in the oral cavity. We utilised HILIC-UPLC to determine glycan surface changes of oral gingival keratinocytes after a 90-minute incubation with Tf. The results show a significant decrease in Sia structures, suggesting that removal of terminal Sias enables other CAZymes to access the underlying glycans, leaving high mannose structures. Intermediate structures of surface N-glycans were not present in our Mass spec analysis indicating that Tf can transport the underlying structures or degrade them further. Then *Escherichia coli* were transformed with a plasmid construct of N terminally His-tagged BFO_0701, and the enzyme was purified. The optimal pH of BFO_0701 was determined, which is pH 5.5. Then we investigated substrate range and enzyme kinetics, where BFO_0701 demonstrated activity against MU-NANA, albeit lower than NanH. Additionally, both NanH and BFO_0701 are active against MU-KDN, suggesting that NanH has a broader substrate range than initially characterised. For both substrates, BFO_0701 displayed positive cooperativity. We therefore suggest that Tf could act upon a greater range of Sias than previously studied, which is significant in the context of host-pathogen and pathogen-pathogen interactions.

66

Does the Impression Thickness Affect the Accuracy of Addition Silicone Impressions and the Resultant casts? A 3D analysis

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Abstract

Objectives. To evaluate the impact of impression thickness on the accuracy of 3 addition silicone materials and their resultant casts using a 3D analysis software program.

Methods. The reference data was obtained by scanning a maxillary Kennedy class II resin cast with a validated desktop scanner. Impressions were taken with 3 monophasic addition silicone impressions (Aquasil, Panasil, and Zhermack) in a digitally fabricated custom tray. Each material was grouped based on impression thickness: (2, 4, 6 mm; n=5 per group). Scanned impressions produced 45 standard tessellation language files. The impressions were poured (type-IV dental stone) and the resultant casts were scanned. A digital metrology program (Geomagic Control X; 3D systems) was used to calculate the root mean square deviations from the reference cast in the entire arch, palate, and dentulous-edentulous (horseshoe) regions. Data were analyzed with multi regression analysis with post hoc Tukey HSD test (α=.05).

Results. The accuracy of all impressions and casts was significantly affected (*P*<.001) by thicknesses and brand, exhibiting higher horseshoe deviations (*P*<.001) compared to palatal deviations regardless of the material thickness. Panasil (6 mm) produced the most accurate impression in all areas, while Zhermack (4 mm, in the palate) and Panasil (2 mm, in the total and horseshoe areas) produced the most accurate cast.

Significance. For prosthesis construction from scanned impressions, 6 mm-spaced trays for Panasil and 4 mm-spaced trays for Aquasil and Zhermack is ideal. For prosthesis construction from the resultant cast, 2 mm-spaced trays for Panasil and 4 mm-spaced trays for Aquasil and Zhermack are recommended.

67

Choosing Wisely in Dentistry: To Dis-invest or Re-invest?

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Abstract

BACKGROUND

The NHS has limited resources and must prioritise the treatments delivered. The Choosing Wisely initiative and the discipline of health economics provide valuable approaches to priority setting and resource allocation. Choosing Wisely was developed to encourage communication between patients and healthcare professionals to prevent unnecessary treatment. Health economics seeks to ensure efficient resource allocation, generating maximum patient benefit per £ spent. The combination of considering incremental benefits against incremental costs, on the one hand, and reducing wasteful, potentially harmful, non-value-adding care, on the other, could potentially achieve “more bang for the buck” in terms of population health outcomes.

AIM

To explore what strategies for mitigating healthcare overuse, taking the Choosing Wisely approach, have been implemented across health care organisations worldwide and to summarise whether and how health economics ideas are combined with the Choosing Wisely approach?

METHODS

A scoping review, using Johanna Briggs Institute methodology.

RESULTS

Six databases were searched (PUBMED, SCOPUS, Cochrane library, EMBASE, CINAHL, ASSIA), identifying 1475 results after de-duplication. Data will be synthesised to identify the use of priority setting tools, their relative advantages and disadvantages, along with instances of relevant stakeholder involvement.

DISCUSSION

NHS dentistry is under unprecedented pressure in the form of elevated demand outstripping supply, highlighting the importance of reducing low-value care and ensuring efficient resource allocation. It is important that decisions regarding the potential re-distribution of these costs are approached in a way which is mindful of benefits, such as the effectiveness, efficiency and equity of the dental care system as well as potential risks, such as reducing patient engagement with dental services. Findings will support the design of Choosing Wisely interventions for the Scottish context.

68

Arts and Science Interface: 3. Public Engagement and Research Dissemination

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Abstract

Introduction:

Head and neck cancer (HNC) has a significant impact on people's health, appearance, function and quality of life particularly for those who have a facial part removed during surgery. For these patients, a removable facial prosthesis can be provided to replace the missing facial part. Research has explored using digital manufacturing technology to improve the way facial prostheses are made from patient, healthcare, and NHS perspectives. However, patients with facial prostheses remain an underserved group that contend with social stigma from their visible facial differences. Public engagement is needed to enable meaningful bidirectional communication with the wider community.

Materials and Methods:

"I'm Still Me" was developed as a patient-centred co-created visual art-science project to raise awareness of the significant impact of HNC on people's lives. An idea generation workshop involving patients, artists, creative writers, clinicians, and researchers established the project name and objectives. Patients who consented to take part were paired with an artist based on pairing suitability and logistics. Meetings were facilitated to discuss plans and expectations for the creation of artworks and narratives.

Results:

A collection of over 20 artworks has been produced. Each patient has had a traditional portrait produced representing a typical day wearing their prosthesis as well as one or more expressive pieces about their lived experiences e.g. the psychosocial impact of treatment, or important factors that supported their rehabilitation. Written narratives describe patients' lived experiences, experience of taking part in research, and artists' creative decision making. A series of exhibitions are planned with diverse audiences.

Discussion:

The project offers new routes for collaboration between patients, clinicians, researchers, artists, and public engagement practitioners to tackle important issues of face equality. It intends to improve patient and public involvement and engagement by ensuring patients' voices are heard and bring science out into the wider community.

69

DIAMETRAL TENSILE STRENGTH EVALUATION OF TEMPORARY RESTORATION MADE WITH SELF-SYNTHESIZED POTATO STARCH ORGANIC FILLER

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Abstract

The use of composite materials in temporary dental restorations, particularly those incorporating starch as an organic filler to prevent allergic reactions, has become popular. This study focused on assessing the Diametral Tensile Strength (DTS) of locally sourced potato starch for dental applications. The starch, sourced from Pangalengan, Indonesia, underwent characterization using Scanning Electron Microscope (SEM), Fourier Transform Infra-red Spectrometry (FTIR), X-ray Diffraction (XRD), and Dynamic Light Scattering (DLS) techniques. The study divided 18 samples into two groups. Group A had a matrix-to-filler ratio of 60:40 (group A0) and employed either (3-aminopropyl)triethoxysilane (APTS) in groups A1 or (3-mercaptopropyl) trimethoxysilane (MPTMS) in groups A2 for silanization. In contrast, Group B utilized a hybrid potato filler with a composition of 35% potato starch and 5% alkali-treated starch (group B0), with silanization using APTS (groups B1) or MPTMS (groups B2). The DTS test using Llyod Universal Testing Machine showed significant differences ($\alpha < 0.05$), with Group A exhibiting higher values (25.29-27.32 MPa) than Group B (14.76-24.06 MPa). Characterization analysis revealed changes in particle morphology and size, transitioning from oval or round shapes to rod-like agglomerations and irregular smaller particles after treatment. The crystallinity also decreased post-treatment. Absorption bands in the FTIR spectra suggested the presence of C-O bonds stretching, indicative of structural changes due to treatment. The use of MPTMS for silanization resulted in higher DTS values (A2 with 26.31 MPa and B2 with 20.77 MPa) compared to APTS. These findings highlight the potential of potato starch as an effective organic filler for modifying the DTS of temporary restorations. Thus, potato starch-based fillers could serve as viable options in temporary dental restorations, offering benefits such as biocompatibility and allergen avoidance.

Keywords: Potato starch, organic filler, diametral tensile strength, temporary restoration.

71

Foundation Dentists' experience in removable prosthodontics

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Abstract

Introduction: As oral health has improved more people are retaining their natural dentition. However, there remains a significant population in the United Kingdom (UK) who are edentulous or partially dentate requiring removable prostheses. Concerns have been made previously that new graduates lack confidence and experience in removable prosthodontics.

Aim: To explore NHS England Workforce, Training and Education North East Foundation Dentists' experience of, and confidence in removable prosthodontics.

Methods: Foundation dentists (FDs) from NHS England Workforce, Training and Education North East were invited to complete an online questionnaire, enquiring about their undergraduate and postgraduate education and training in removable prosthodontics, numbers of completed dentures, materials used and how their confidence changed in removable prosthodontics during Dental Foundation Training (DFT).

Results: Twenty-two FDs responded, qualified from 9 of the 16 dental schools in the UK. FDs rated their undergraduate training to be good or very good in compete and partial dentures, but fair to very poor for implant supported overdentures. When asked how their confidence changed during DFT in the provision of acrylic partial dentures 20 reported increased and 2 remained the same. Whereas, for cobalt chrome partial dentures 6 reported a decrease in confidence, 4 remained the same and 12 reported improvement. For complete dentures 16 reported improved confidence, 4 remained the same and for 2 confidence decreased. Further training received included one-to-one tutorials, study days and case-based discussions. The average number of dentures completed as an FD were: complete denture 5.5 (range 0-15), partial acrylic denture 16.1 (range 3-50) and partial cobalt chrome denture 1.9 (range 1-4).

Discussion: Respondents reflected positively on both undergraduate and postgraduate teaching. Improved confidence was reported in the provision of removable prostheses where they had gained the most experience. Experience levels varied amongst respondents, demonstrating variation in demographics even within a small catchment area.

72

Deriving a classification system that is amenable to valuation for use in adult oral health economic evaluations.

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Abstract

Generic Quality Adjusted Life Years (QALYs) are widely used in economic evaluations of health care interventions, but they lack sensitivity to capture care outcomes of value to dental patients. Existing oral health related quality of life (OHRQoL) instruments for adults cannot be used to generate QALYs because they are not preference-based measures. The OHIP-14 is a well-established OHRQoL instrument, but the large number of possible health states it produces makes valuation methods for deriving preference-based weights impractical.

Aim: To derive a shortened classification system for the OHIP-14, that is amenable to valuation for use in economic evaluation.

Methods: Exploratory factor analyses were used to identify structurally independent dimensions. Rasch analyses per dimension and classical psychometrics informed the selection of the most appropriate items for the classification system, excluding poorly fitting items and choosing those with the widest spread across the latent trait. Response level reduction was explored using Rasch category probability thresholds. Assessments were done using the Adult Dental Health Survey 2009 dataset (N: 11380) and validated using datasets from two clinical trials (N: 2372; N: 1877).

Results: Four dimensions were identified within OHIP-14 (“General function impact”, “Psychological impact”, “Oral function impact”, and “Orofacial pain”). Rasch analyses indicated the selection of the items “being irritable with others”, “feeling tense”, “unsatisfactory diet”, and “aching pain”. A reduction from five to three response levels generated ordered thresholds, improving the clarity and distinctness between response categories.

Conclusion: The OHIP-14 can be reduced into a four-question, three-level response, health-state classification system. Future work will incorporate qualitative feedback to refine the classification system and a Discrete Choice Experiment to derive preference-based weights. To our knowledge, this constitutes the first attempt to generate a preference-based measure specific for adult dentistry based on a well-established adult OHRQoL instrument.

73

CHARACTERIZING THE SALIVARY MICROBIOME TO ELUCIDATE THEIR FUNCTIONAL RESPONSE TO ORAL ACTIVES

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Abstract

The oral microbiome is a complex community of commensals, symbionts, and pathogens. While previous research has primarily focused on taxonomic classification in both healthy and diseased states, there remains a significant gap in knowledge regarding the functional dynamics of this intricate ecosystem particularly with continuous exposure to sub-lethal doses of common oral actives. The aim of this study is to investigate the response of the oral microbiome to sub-lethal doses of antimicrobials, particularly Chlorhexidine (CHX), Stannous fluoride (SnF2) and a novel compound 2-isopropyl-5-methylphenol (IPMP). Utilising biofilms derived from healthy human saliva and an 8-species bacterial consortium, modified Nanopore pipelines were employed to characterise microbial composition. Viability assessments using LIVE/DEAD staining and scanning electron microscopy (SEM) imaging were conducted to examine the impact of CHX, SnF2 and IPMP on biofilm integrity. Protein extraction was followed with liquid chromatography mass spectrometry analysis to obtain the proteomic profile of treated biofilms. Individual species within the biofilms were exposed to varying concentrations of CHX, and resistance was monitored through passaging on CHX supplemented agar plates. Disk diffusion assays (DDA) were employed to evaluate the sensitivity of CHX-treated species to common antibiotics. Salivary biofilms subjected to 16S rRNA sequencing revealed the composition of bacterial biofilms treated with CHX, SnF2 and IPMP exhibited altered composition of specific oral commensals. Live/dead staining showed a large number of non-viable cells in the treated biofilms. SEM imaging illustrated the spatial organisation of biofilms and the adverse effects of the oral actives. Minimum inhibitory concentrations of CHX varied between 0.02% and 0.002% across individual species and passaging indicated tolerance. We have demonstrated methods to study the dynamic response of the oral microbiome when exposed to varying concentrations of common antimicrobials used routinely. Future work will provide insight into the functional changes and potential interactions within the microbial community.

74

Approaches to 3D Printing a Realistic Implant Surgical Model

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Abstract

Background: In dental education, there has been a recognised issue concerning the tactile sensation (haptics) of surgical training models compared to real-life surgery. Students have observed a discernible difference in texture and consistency between the models and actual tissues.

Objectives: This study aimed to develop a methodology for producing lifelike surgical models suitable for teaching implantology, employing micro-CT techniques for anatomical replication and 3D printing of materials with similar tactile properties.

Methods: Porcine mandibles were scanned at a resolution of 15µm using micro-CT, and the resulting images were converted into a 3D digital model suitable for 3D printing. A methacrylate-based resin consisting of urethane dimethacrylate (60wt.%), triethylene glycol dimethacrylate (35wt.%), lucirin TPO (2wt.%), and titanium dioxide (3wt.%) was utilised with a DLP 3D printer. Replicas of the mandibles were printed and then scanned with micro-CT to assess fidelity. Mechanical tests, including compressive strength, elastic modulus, hardness, and haptic measurements, were conducted on the printed mandibles.

Results: Micro-CT imaging confirmed the accurate reproduction of the porcine mandibles in the 3D-printed replicas. The methacrylate-based resin exhibited radiopacity under X-rays, a crucial property lacking in some current surgical models. The haptic measurements of the replicas demonstrated similar cutting forces compared to the porcine mandibles (0.62N and 0.55N, respectively).

Conclusion: These findings indicate that the 3D-printed replicas could serve as effective training aids for dental students, providing a more authentic learning experience. Future research will involve comparing these replicas to existing models and gathering feedback from both students and professionals.

75

Arts and Science Interface: 1. Interdisciplinary implications for dental research.

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Abstract

Background

This paper is based on the collaboration between arts and science that started when a local artist practitioner got involved with a social science project looking at the experience of tooth loss and living with a denture.

Aim

The aim of this presentation is to discuss the intersection between dental research and art as practice.

Results

The original data for this study was collected from narrative interviews completed with 20 participants (11 males and 9 females, age range 22 to 86 years). The artist practitioner examined the narrative data and discussed the findings with the PI. The discussion focused on how these experiences might best we drawn into an art piece. The discussion turned around the diversity and complexity of each participant's journey from tooth loss into living with a denture. The analysis also examined key social scientific concepts, including 'mirrors and masks' associated with the work of Goffman in sociology. Alongside heat mapping in colour and psychology to capture the complex range of emotions experienced by participants. The resulting artwork produced a profound image depicting three patient journeys expressing a range of impacts and outcomes. This art piece subsequently acted back onto the science, pushing the scientific team towards a much more person-centred measurement tool for future research.

Conclusion

The interdisciplinary intersection of art and science in dentistry promises new groundbreaking directions for person-centred research and practice.

Funding: The original study and the Art piece were funded by Haleon. The art work was produced independently and was not influenced by Haleon in any way.

76

Peptide-Enhanced Calcium Phosphates for the management of Medication Related Osteonecrosis of The Jaw

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Abstract

Medication-related osteonecrosis of the jaw (MRONJ), characterised by necrotic bone exposure, is a side effect of bisphosphonate (BP) treatment. Bacterial colonisation is a major challenge in MRONJ pathophysiology. Calcium phosphate materials have shown the ability to reduce the toxic effects of BPs on oral mucosa cells, likely through their ability to reduce the local concentration of BP. Antimicrobial peptides (AMPs) have a broad spectrum of antimicrobial activity and minimal resistance. This study aimed to investigate the effectiveness of AMP-coated discs for the treatment or prevention of MRONJ infections. Swabs were taken from MRONJ patients who presented at the Charles Clifford Dental Hospital for treatment (REC reference: 20/WS/0165). Several types of bacteria were isolated from the samples and cultured for use in antimicrobial studies after identification using 16S rRNA sequencing. Anaerobic bacteria, namely *Actinomyces spp., Provetella spp., Fusobacterium spp., and Cutibacterium spp.,* were used in the antimicrobial investigations. The antimicrobial activity of peptides (Kr-12 and KRSR) were tested on MRONJ bacteria samples using the microdilution broth assay and Kr-12 peptide showed antibacterial activity at concentrations less than 200 µg/ml. Peptides were then attached to calcium phosphate discs using carbodiimide chemistry which was confirmed using FTIR and XPS. Peptide-coated discs were tested against MRONJ-associated bacteria using the Miles and Misra method. The viability of MG-63 bone cells cultured alongside peptides and peptide-coated discs was tested and no reduction in viability was observed for concentrations less than 1 mg/ml. Antibacterial properties of peptide coated discs might improve MRONJ management.

77

How do undergraduates studying Medicine, Dentistry & Biomedical Science perceive research?

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Abstract

Whilst academic staff may perceive research to be an integral part of higher education it is less clear if this view is shared by undergraduate students, including those in healthcare professions, and what 'value' they assign to it. Therefore, the aim of this study was to investigate students' perceptions of research.

Methods

A survey was distributed by email to all undergraduates in the University of Plymouth Schools of Medicine, Dentistry, and Biomedical Sciences. Items included Yes/No questions, agreement scale questions related to statements and free text questions to capture attitudes and opinions. University ethical approval was obtained. 42 responses were received from students across a variety of programmes and stages of study which were subjected to quantitative as well as inductive thematic analysis of the free text responses.

Results

Whilst nearly all students had experience of research articles and databases, less had participated in or were even aware of research opportunities. However, students felt strongly that research was important to the advancement of their subject and careers with 'evidence-based practice' being a common theme. Staff involved in research were thought to be better informed.

Conclusion

Whilst there is clear pressure on timetables and curricula especially if training a greater number of healthcare professionals more quickly, research and research skills are clearly valued by students as a transferable skill and the case should be made for protection or even enhancement of provision for research opportunities within programmes.

78

Soluble Tumour Microenvironmental Signals Modulate Anti-Tumoural Response of M1-like Macrophages.

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Abstract

Background & aim: Oral Squamous Cell Carcinoma (OSCC) remains associated with a poor prognosis and is characterised by a high density of anti-inflammatory, pro-tumoral macrophages (M2) within the tumour microenvironment, linked to immune suppression, tumour-progression and metastasis. Activated macrophages (M1) that are pro-inflammatory respond to environmental changes such as the presence of infection, and tumour derived signals. The latter can drive the repolarisation of M1 macrophages to M2, which in turn promotes tumourigenesis. The aim of the study was to investigate the effect of OSCC cell conditioned medium on the response of M1 macrophages.

Methods: THP-1 pro-monocytes were used to derive macrophages, to be a model of immune response and tumour associated macrophages. These macrophages were pre-stimulated with conditioned medium from OSCC cells, to mimic tumour environmental signals. The macrophages were then stimulated with lipopolysaccharide (LPS) from either the oral pathogen *P.gingivalis* or *E.coli*. The resulting supernatant was assayed using sandwich ELISAs to measure the response of pro-inflammatory cytokines (TNFα (Tumour Necrosis Factor Alpha) and IL-6 (Interleukin-6)) to the tumour environmental signals.

Results & conclusion: Macrophage secreted TNFα levels were reduced by approximately 50% in response to the conditioned medium. Thus, tumour environmental signals may supress the pro-inflammatory cytokines that are released from macrophages, producing a pro-tumoural environment. Further work investigating the relationship between macrophages and tumour progression, will be performed using co-culture and a 3D immunocompetent oral mucosal model.

79

Preliminary Experiments in Binding Mucins to Synthetic Surfaces

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Abstract

To improve the efficacy of oral actives such as chlorhexidine, fluoride, and zinc, their retention on oral mucosal surfaces is investigated. The mucosal pellicle (MP) is a hydrogel covering the epithelial cells within the oral cavity. Large, highly glycosylated salivary mucins (MUC5B and MUC7) bind to cell membrane-bound MUC1. Mucin-mucin interactions, specifically between MUC1 and MUC5B, are critical for pellicle structure. Hydrophobic, ionic, and van der Waals interactions are thought to control MP formation. Previously, cell models have been used to investigate how mucins bind but are unsuitable for drug retention studies due to toxicity effects.

Binding of commercially available mucins and human saliva to polystyrene particles was investigated as a starting point to understand mucosal pellicle formation. Polystyrene particles are model hydrophobic surfaces which typically bind proteins well. Following standard incubation conditions neither bovine submaxillary mucin, nor salivary mucins bound well when quantified by SDS-PAGE/ CBB/ PAS staining. As a second strategy mucins were assessed for their ability to be immobilised by activated cyanogen bromide particles. These commercially available particles are commonly used to selectively bind amino groups of the protein to the particles. Again, however, no significant binding was found for mucins. Future studies will investigate the ability of a glycosylated and non-glycosylated MUC1 (using a bacterial and mammalian expression system) to anchor to a polymer surface and then further attach MUC5B and MUC7 binding partners through hydrophobic and ionic interactions. In conclusion, binding MUC5B to surfaces is not straightforward.

80

Measuring Tooth Wear Accurately

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Abstract

Intra-oral scanners (IOS) capture the 3-dimensional topography of the oral anatomy. Emerging evidence supports the use of intra-oral scanners (IOS) to measure tooth wear quantitatively but it is not known how accurately they can measure the depth and width of a crater. We aimed to evaluate the effect of pre-alignment of sequential intra-oral scans before the measurement of step height of free-form surfaces.

Four typodont teeth of the upper right second molar tooth (UR7) were baseline scanned using a non-contacting laser profilometer (NCLP) and a Primescan® Intra-oral scanner. Craters of depth 22, 42, 62, and 82 microns were created on the mesio-buccal cusp and captured with the same scanner. The scans were repeated five times. All post-crater scans were aligned to their baseline scan counterparts. As an additional step, the scans from the IOS were aligned to the z-axis and compared to unaligned scans. Baseline and post-crater scans were analysed using a software measurement workflow using reference best-fit alignment and surface subtraction to give the residual surface change. The automated area detection method was used for 2-dimensional area measurements. Manual step-height measurements were used for crater depth measurements.

The IOS detected craters accurately at 88 µm after scans were aligned to the Z-axis, mean (SD) (0.70 mm^2 (0.04)). At the same depth, without alignment, 60% of scans could accurately detect crater lesions on plastic teeth models, (0.80 mm^2 (0.12)). The measurement error also decreased as the depth of a crater deepened and after scan alignment.

The point spacing of IOS scan outputs varied between 45 to 129 µm but the data points were the closest together in the z-axis. In conclusion, aligning craters to the z-axis helps to improve the accuracy of step-height measurements.

81

Exploration of the suitability of Foundation Dentists to support the RAISED in Yorkshire community engagement programme.

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Abstract

Background: Yorkshire has the second-worst UK prevalence of tooth decay affecting 45% of 12-year-olds. Caries is concentrated to high-risk groups within socio-economically deprived areas creating considerable health, economic and social burdens.

RAISED in Yorkshire (RiY) aims to reduce these burdens by utilising Foundation Dentists (FDs) to train 16-18 year-old students to become Student Research Fellows and subsequently deliver oral health education to their 11-12 year-old peers. The impact of this peer-to-peer education is measured by pre- and post-intervention oral health assessments, also collected by FDs. Engagement of FDs in this programme was felt to be bi-directional as FDs gain professional and personal skills, however, these experiences have not been explored.

Aim: To ascertain the suitability of FDs to support the RiY programme by exploring their experiences and identify skills gained from this community engagement programme.

Methods: An online questionnaire was distributed to the FDs and was analysed using descriptive statistics. Participants were also invited to a face-to-face focus group using semi-structured questions. Responses were transcribed verbatim and analysed by thematic analysis.

Results: Thirty FDs completed the questionnaire; seven FDs were additionally recruited for a focus group, yielding quantitative and qualitative data respectively. Over 90% of FDs documented positive responses to engagement in RiY with over half highlighting clinical, professional, and academic skills gained. Key barriers to FDs participating in RiY were identified, including organisational and training needs.

Conclusion: FDs were confident to deliver the RiY aims and offer a sustainable way to expand the RiY programme. FDs felt they were well suited to training 16-18 year-olds as Student Research Fellows and performing participant dental assessments. FDs saw benefits of participation in this community engagement programme and the bi-directional gain from exposure to research. We recommend utilisation of FDs for RiY expansion to other regions, with support from dental foundation deaneries.

82

Examiner Alignment for Periodontal Clinical Research – a pragmatic method

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Abstract

Objectives: Examiner alignment and assessment (or calibration) is an important step in clinical research but challenging in periodontal studies. We present a pragmatic method of periodontal examiner alignment.

Methods: 11 examiners attended a two-day exercise as part of the ENHANCE-D Trial. This included study familiarisation, protocol review, training on periodontal measures and a series of alignment exercises on training models and photographs. Probing pocket depths (PPDs) and gingival recession (REC) were assessed on training models; plaque index (PI) and gingival index (GI) from clinical photographs. Gold standard measurements were established by experienced examiners for PPD and REC. Repeat models/photos were presented to examiners without their knowledge to assess intra-examiner reliability. Live data were presented during the session, and additional training and repeat exercises completed where necessary.

Results: Good agreement was achieved between the examiners and the gold standard, with 9 of the examiners achieving at least 93% agreement (within 2mm) for 162 PPD measurements (remaining examiners: 88% and 78%) and all examiners achieving over 90% agreement (within 2mm) for REC measurements. For the trial's primary outcome measure (percent of sites with PPD>=5mm) all the examiners deviated by no more than 13 percent from the gold standard. Intra-examiner reliability was varied and resulted in additional targeted training. PI was poorly aligned with a wide distribution of values for each site. GI was moderately aligned.

Conclusions: This pragmatic method allowed a large number of examiners to be trained and aligned to achieve good agreement for PPD and REC measures.

83

RAISED in Yorkshire [RiY, Research Activity in School Evaluating Dental Health] – a peer-to-peer citizen science oral health programme co-designed with secondary schools located in West Yorkshire, UK in areas of social deprivation

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Abstract

Background: Tooth decay in secondary school children is highly prevalent with ~45% of 12 years olds affected in Yorkshire (Rooney et al 2010); disproportionately affecting lower socioeconomic groups. Novel school-based oral health (OH) prevention strategies targeting tooth decay are needing to be evaluated.

RAISED in Yorkshire (RiY) offers a novel peer-to-peer delivery approach. RiY is a feasibility randomised controlled trial (RCT) of a complex intervention following a Citizen Science Approach. RiY trains 16-19-year-olds as oral health educators 'peer leaders' who then deliver OH interventions to 11-12-years old students. RiY relies on shared cultural backgrounds and relatability to reach students that may be missed by typical healthcare professional-led interventions.

Aims: To improve oral health knowledge, toothbrushing skills and behaviour, reaching into underserved communities.

Methods: This is a school-based, assessor blinded, feasibility RCT running over 2 school years, 2022-2024 to inform the design of a definitive RCT.

Outcomes: The primary outcome is the feasibility to deliver the RiY intervention. The secondary outcomes, include the oral health of participants (plaque and gingival index, knowledge, attitudes and behaviour), sustainability, alongside, process evaluation.

Results: The feasibility trial recruited 467 11-12 year-olds students and 114 16-19 year-olds 'peer leaders' across six schools in West Yorkshire, UK. Preliminary data analysis has highlighted up to a 74.9% improvement in plaque scores in participants pre- and post- intervention. Sustainable delivery of the RiY programme was demonstrated utilising 57 Foundation dentists to train the peer leaders whilst gaining research exposure by performing dental assessments.

Discussion: RiY is a prevention programme that successfully reaches 'at risk' adolescents from areas of deprivation and high oral health inequalities to improve oral health in a sustainable way. The programme is planning to roll out nationally, expanding to other schools using a 'RAISED in …' approach.

Rooney et
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84

Oral Soft Tissue Angiography Imaging Using a Hand-held Intraoral Probe

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Abstract

The early identification of potentially malignant oral lesions and cancers correlates with improved outcomes and prognosis. The transition from normal to malignancy is associated with an increased vascularity. Biopsies, though the current gold standard, are invasive and entail both costs and morbidity. Optical coherence tomography-based angiography (OCTA) offers a non-invasive, high-resolution imaging solution, presenting significant potential for screening soft tissue lesions in the oral cavity. This study evaluated the efficacy of a hand-held OCTA probe on the buccal and labial mucosa of 10 healthy volunteers to establish normal vascular networks. The probe's field of view extends up to 9mm in diameter with an imaging depth of approximately 1.7mm. To reduce motion artifacts and scanning time, data processing incorporated the windowed Eigen-decomposition algorithm. Quantitative assessments were performed using adaptive thresholding and Hessian filtering. Quantitative angiography of the buccal mucosa revealed an average vessel density of 62.96% (σ=2.99%), vessel diameter of 80.94µm (σ=6.71), and weighted tortuosity of 1.29 (σ=0.036). Comparable metrics in the labial mucosa showed a vessel density of 65.67% (σ=2.80%), vessel diameter of 87.28µm (σ=5.64), and tortuosity of 1.29 (σ=0.027). These results suggest that hand-held intraoral OCTA probes could play a pivotal role in the early detection of premalignant conditions by highlighting distinct vascular anomalies. Consequently, this technology could transform diagnostic imaging of oral mucosa and guide clinicians towards areas requiring further examination. In summary, while further studies with larger and more diverse datasets are necessary, preliminary findings support ongoing development of OCTA technology and software, potentially enhancing clinical diagnostic capabilities within oral healthcare.

85

ACTIVITY OF ORAL NITRATE-REDUCING BACTERIA AND BLOOD PRESSURE LEVELS IN DENTAL PATIENTS.

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Abstract

Objectives: Oral nitrate-reducing bacteria (ONRB) increases nitrite bioavailability, a key nitrogen compound that can reduce blood pressure by increasing nitric oxide synthesis (NO). Furthermore, recent evidence suggests that ONRB play a key role in regulating salivary pH by consuming lactate and producing ammonia. Currently, there is limited knowledge about the activity of ONRB in patients with hypertension. Thus, this study aimed to analyse the activity of ONRB as well as lactate, glucose and ammonia levels in hypertensive patients compare to normotensive patients attending a primary care dental school in the UK.

Methods: Activity of ONRB and salivary levels of nitrate, nitrite, lactate, glucose and ammonia as well as salivary acidity (pH) and buffering capacity were measured in 40 normotensive [NT] (SBP≤129 and/or DBP≤79) and 31 hypertensive individuals [HT] (SBP≥140 and/or DBP≥90) participants. Blood pressure was also measured in all the participants.

Results: Activity of ONRB was significantly higher in the HT group (556±551µM) compared to NT group (327±252µM;p=0.046), however, salivary levels of nitrate and nitrite were not significantly different between both groups. Salivary ammonia (HT=33±39µM; NT=55±39µM;p=0.003) and pH (HT=7.02±0.44; NT=7.15±0.37;p=0.043) were significantly lower in the HT group compared to NT group. Additionally, significant negative associations were observed between systolic blood pressure (SBP) and pH (Adj R^2=0.244,p=0.044), ammonia (Adj R^2=0.263,p=0.012), and buffering capacity (Adj R^2=0.276, p=0.005).

Conclusions: While the activity of ONRB was higher in the HT group compared to the NT group, salivary levels of nitrate and nitrite were not different between groups. On the other hand, lower salivary pH and ammonia levels and associations between these parameters and SBP may suggest alterations in the abundance of ONRB or other bacterial species interfering with the oral nitrate/nitrite pathway in HT individuals. This must be confirmed in future studies.

86

Validation of a preliminary classification system for a malocclusion-specific preference-based measure of oral health-related quality of life.

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Abstract

Background: Preference-based quality of life measures (PBMs) have been developed in many clinical areas to aid in estimating more accurate utility values for economic evaluations. However, there is a lack of economic evaluations to assess the cost-effectiveness of malocclusion treatment in adolescents. The scarcity of economic evaluations might be due to the need for an appropriate instrument for measuring Quality Adjusted Life Years (QALYs). A preliminary five-item malocclusion-specific preference-based classification system adapted from the Malocclusion Impact Questionnaire (MIQ) was identified using Rasch analysis, psychometric testing, involvement of adolescents and discussions with the original developers of MIQ.

Aim: To validate a preliminary classification system for a preference-based measure specific to malocclusion in adolescents.

Methods: Validation was undertaken using a sample of patients aged 10 to 16 years old from the UK who have been referred to orthodontic clinics. Qualitative, semi-structured cognitive interviews with adolescents were conducted online. Adolescents were asked to 'think aloud' while completing a reduced version of the MIQ relating to the items within the preliminary classification system. Participants were also shown the questions previously excluded from the classification system and asked if they think any of them should be reintroduced and why.

Results: Adolescents found the preliminary questionnaire questions straightforward and did not face any difficulty in answering them. Older participants expressed that '*being bullied*' would be important to include, as they believe their peers would be likely to get bullied because of their teeth. Adolescents thought that the items '*confident*' and '*smiling*' overlapped, as they felt they would be unlikely to be bothered about their teeth while smiling if they were confident.

Conclusion: Adolescent-centred modifications to the classification system were made in line with the findings from the interviews. Following review by adolescent representatives for the study, the classification system will be ready for valuation.

87

A Pilot Study of Leadership by Final Year Dental Students during a simulated Medical Emergency.

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Abstract

Abstract

In primary care it is important that all staff are competent to manage medical emergencies and when such situations arise the dentist takes the leadership role. In the undergraduate curriculum students are expected to become competent to manage medical emergencies and are routinely assessed on this area. They are also expected to develop leadership skills, however, assessment of this requirement is not common.

The aim of this pilot study was to determine if final year students could safely and effectively lead a team managing a simulated medical emergency.

Ten final year students volunteered to take part in one of eight emergency scenarios with a team made up an ICU nurse, a dental nurse/ life support trainer, and a third year dental student. Their ability to lead the scenario was assessed by the school resuscitation/ medical emergency lead using a checklist-based assessment tool awarding a global score. Each of the team also provided feedback of the leadership of the student and the student reflected on their performance.

All ten students satisfactorily completed the task, but leadership skills varied from outstanding to a bare pass. Feedback from the team included areas such as the student's confidence, communication with clear instruction and delegation, nervousness or being calm and controlled. A lack of knowledge or understanding did adversely affect the leadership performance.

The findings of this pilot study conclude that such an exercise would be a good way for final year dental students to develop leadership skills. The benefits for those who struggle would be to suggest feedback on areas where they can improve and for those who flourish; it would be a way of cementing their leadership skills as they leave the safety net of studying at university and beginning a career in dentistry.

88

Educators' Perceptions and Challenges of Student Assessment Process at Prince Sattam bin Abdulaziz University Dentistry Program: A Qualitative Study

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Abstract

Background: As part of Saudi Vision 2030, there is an increasing demand for dentistry colleges to provide training in the student assessment process. Assessment is the process of accurately determining a learner's skills across multiple educational domains. The objectives of this study were to investigate teachers' perspectives and challenges, and make recommendations for improving the assessment process of undergraduate dental students at Prince Sattam bin Abdulaziz University in Al-Kharj, Saudi Arabia.

Methods: A qualitative study employed the grounded theory approach following purposive sampling. Four focus group interviews were conducted with course directors from the College of Dentistry at PSAU, using open-ended questions for data collection. Otter software was used for the transcription and NVivo 14 for data analysis.

Results: Four themes emerged: perspectives on the process of assessments, summative and formative assessments, challenges of assessments, and solutions to the challenges of assessments. Most educators perceived assessments as assessments of learning, with the planning and execution of assessments requiring regulation. Different feedback models were occasionally used by examiners to improve student performance. Examiner standardization training, communication, and calibration were lacking, according to educators' perspectives.

Conclusion: The challenges of the assessment process in the College of Dentistry at PSAU are multifactorial, including the examiners themselves, students, and the college. These challenges identified a need for a tailored, properly designed faculty development training program related to different methods of student assessment.

Keywords: challenges, educators' perceptions, student assessment, undergraduate dentistry course.

91

Investigation of a Novel Bioactive Restorative Material to Promote Gingival Attachment

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Abstract

Introduction: Root lesions are becoming increasingly prevalent as older age groups retain teeth for longer and root surfaces becomes exposed following gingival recession. These lesions result from attrition/abrasion or caries. As life expectancy is increasing globally (WHO), management of root surface lesions will become an increasingly important challenge for dentistry. Restoring such defects is challenging because of the difficult isolation and the proximity to gingival tissues which could trigger periodontal inflammation due to biofilm formation and/or material toxicity. The aim of the present study was to investigate epithelial attachment to commonly used resin-based materials and a novel restorative material. **Methods:** Discs (10mm-diameter, 2mm-thickness) of resin-based materials (Fuji II, G-aenial anterior, Bioactiva) and a strontium substituted bioglass-based prototype (Sr-prototype) were used for this study. Ion concentrations and pH of immersion media were determined following exposure to the test materials. Viable H400 cell attachment on fresh/aged specimens (7-days aged in media) was determined quantitatively using the trypan-blue dye exclusion assay and qualitatively assessed using SEM 48 hours after seeding. The indirect effect of the test materials leachate concentrations on cell attachment to tissue culture wells were also investigated. **Results:** The Sr-prototype significantly raised the media pH and released the highest amounts of Si^{4-} and Sr^{2+} for 7 days. Significantly more viable cells were found attached to the Sr-prototype compared with other materials for both fresh and aged samples. For all materials leachate concentrations, cells exposed to the Sr-prototype leachates showed significantly higher attachment to the cell culture wells compared with other materials ($p<0.0001$). Two-way ANOVA revealed that the interaction between material type and leachate concentration significantly affected viable cell attachment ($F(10,144)=38.99$, $P<0.0001$). **Conclusion:** The Sr-prototype showed promising preliminary results that suggested potential as a novel restorative material that may enhance gingival attachment to regain the tight biological seal around restored tooth.

92

Dental undergraduate and young dentist awareness and attitude toward the local anaesthesia technique and related failure in oral surgery

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Abstract

Objectives: The aim was to highlight the students, interns, and junior dentists' awareness and attitude toward the inferior alveolar nerve block, failure, and related complications in the KSA.
Methods: An open web-based survey prepared according to CHERRIES recommendations was designed and carried out across different regions of the KSA. The questionnaire was composed of four main sections including the participant's details, and qualifications; inferior alveolar nerve block delivery; participants' education, and training-related questions; and attitudes toward proposed solutions to overcome the related failure and complications.

Results: 262 participants completed the questionnaire (94 dental students, 79 interns, and 89 junior dentists). There was a significant difference in the following findings: males performed IANBs more frequently than females ($P < 0.05$); females, students, and private practice/University type showed less attendance to workshops and seminars on IANB with more need for training ($P < 0.05$); females were more in agreement with ''continuous education courses'' and ''workshops done by specialists'' to propose solutions to overcome IANB failure ($P < 0.05$). The multivariate logistic regression analysis showed that qualification and attendance of a training course were strong predictors of participants' readiness to manage IANB complications ($P < 0.05$).
Conclusions: The findings emphasize how crucial it is for early dental practitioners to participate in continuing professional development programs to enhance their capacity to administer IANB and handle complications.

Clinical Significance: Exploration of early practicing dental professionals' awareness and attitude toward IANB will directly inform efforts to improve clinical practices and ensure patient safety.

93

Effect of Bioglass particle size on light transmittance of photocurable composites

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Abstract

Background: Photocurable, ion-releasing composites containing ion-leachable glass exhibit limited light transmission through depth leading to sub-optimal degree of polymerisation. Whilst refractive index (RI) matching of the glass filler can improve translucency, modification to reduce its density can alter network configuration and negatively affect remineralisation potential of the material.

Aim: To improve light transmission in ion-leachable materials through the modification of particle size without glass compositional changes.

Methods: Composite specimens consisted of 45vol% resin (BisGMA: TEGDMA; 60/40), 55 vol% Sr-SiO_2 glass (RI=1.51) for the control, while the experimental group contained 45 vol% Sr-SiO_2 glass and 10 vol% 45S5® Bioglass (RI=1.56) in four particle sizes. Transmittance was measured using UV-Vis spectroscopy. The RI of the pre-cured and post-cure resins were determined using an Abbé refractometer, and the particle sizes of the experimental BGs were confirmed using a laser diffraction analyser. Statistical analysis was conducted using two-way ANOVA and Holm-Sidak tests ($p<0.05$).

Results: Composites with an average Bioglass particle size of 16µm ± 4µm exhibited the highest light transmittance, followed by the control group and those with particle sizes of 7µm ± 1µm and 4µm ± 0.5µm respectively ($p<0.001$). The 2µm ± 0.5 µm BAG filler showed the lowest light transmittance value ($p<0.001$). The pre-cured resin had an RI of 1.508, while the post-cured resin had a refractive index of 1.542. The Bioglass particles provided as 2µm, 4µm, 7µm, and 16µm, were actually 4.8µm, 9.4µm, 10.1µm and 18µm, respectively.

Conclusions: Inefficient light transmission is a result of absorption, scattering and reflection. Whilst optical matching of filler and resin RI can reduce interfacial light scattering, filler particle modification may compensate for high density, high RI fillers to improve light transmission without compositional changes to the glass.

95

The Cycle of Influence: Oral Health and Well-being

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Abstract

Background: Well-being encompasses pleasurable experiences (hedonic) and living life with purpose, including personal growth (eudaimonic). Measuring the impact of oral health on well-being might offer a more comprehensive understanding of the psychosocial dynamics of inequalities in oral health, beyond the study of impacts on daily functioning.

Aim: To examine the impact of losing teeth and having a denture on a sense of well-being.

Methods: The study involved analysis of twenty interview transcripts from a secondary dataset of individuals experiencing tooth loss and denture replacement (11 male; 9 female; age range 22-86 years; mean 58.9 years). For hedonic well-being, a case study approach was used, summarising each participant's story to capture a holistic perspective on each person's well-being. Eudaimonic well-being was analysed using a framework approach.

Results: Participant journeys showed how oral health can impact on hedonic well-being through impacts on positive and negative emotions, leading to impacts on overall life satisfaction and, in some instances, impacts on the overall fulfilment of desires. The narratives explicitly addressed some eudaimonic domains (self-acceptance and positive relationships), whilst others could be observed from the background implications of the narratives (autonomy, environmental mastery, personal growth, and purpose in life). How these domains were affected by oral health enables the examination of pathways towards how inequalities in oral health can impact someone's life overall (general inequalities). Likewise, the data reveal how overall well-being can affect oral health.

Conclusion: The findings of this study highlight the importance of considering the complex, circular relationship between oral health and well-being. It also reveals how inequalities in oral health may be related to inequalities in general, and how such broad inequalities can impact back on oral health-related well-being.

96

Trends and socioeconomic inequalities in the dental attendance of adult smokers in Scotland from 2009 to 2019, a repeated cross-sectional study

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Abstract

Background: Smoking is the single largest cause of preventable disease and death globally and a major contributor to health inequalities. Dental professionals are well placed to offer behavioural support in combination with pharmacotherapy to smokers. We aimed to investigate trends and socioeconomic inequalities in the dental attendance of adult smokers in Scotland between 2009 and 2019, with a view to assessing the potential population reach of dental professionals to provide smoking cessation interventions.

Methods: A secondary analysis was conducted of combined year Scottish Health Surveys spanning 2009 to 2019. 'Recent' dental attendance (within the past two years) was the focus and descriptive analysis examined attendance of self-reported smokers compared to non-smokers by the area-based Scottish Index of Multiple Deprivation (SIMD) and individual socioeconomic measures (income, education, and occupation). Generalised linear models assessed recent attendance in non-smokers relative to smokers adjusted by age, sex, survey year and socioeconomic measures for each survey cohort. Absolute differences and risk ratios were calculated with 95% Confidence Intervals (CI).

Results: Recent dental attendance was generally high and increased in both smokers (70% to 76%) and non-smokers (84% to 87%) from 2009/11 to 2017/19 and increased across all SIMD groups. After adjustment for sociodemographic variables, the adjusted Risk Difference (aRD) between non-smokers and smokers was 8.9% (95% CI 4.6%, 13.2%) by 2017/19. Within smokers, recent attendance was 7-9% lower in those living in the most deprived areas compared to those living in the least deprived areas over time.

Conclusions: A high and increasing proportion of smokers in the population attend the dentist, albeit slightly less frequently than non-smokers. Dental settings provide a good potential opportunity to deliver population-level smoking cessation interventions, but smokers in the most deprived and older age groups may be harder to reach.

Keywords: Smoking; Dental attendance; Smoking cessation; Dental settings; Inequalities

98

Arts and Science Interface 4: RiY-ESCALATOR – Empowering student peer-leaders to improve oral health of peers using creative arts and media –A co-production project

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Abstract

Background: Tooth decay is a public health problem nationally and particularly in West Yorkshire. Tooth decay in 12-year-olds is significantly higher in this county than the national average. Tooth decay also disproportionately affects those from a lower socioeconomic group, this economic and social burden compounds the health inequalities experienced.[1]

Raised in Yorkshire (RiY) is a programme that aims to reduce these burdens by training 16-19-year-old students to become Student Research Fellows (RiY-SRF) acting as peer-leaders to deliver oral health promotion to 11-12-year-olds in their schools.

Research literature shows that peer-leaders can be empowered to design and implement health interventions creating an efficient approach to identify their community needs and act upon them2. RiY has adopted this approach to addressing oral health inequality in Yorkshire.

Aim: To use creative arts to engage children with their oral health delivered by RiY-SRFs.

Methods: Using Gadin's[3] participation continuum across its four forms; participation as consultation, participation as means, substantive participation, and structural participation, RiY-SRFs were asked to design and produce short arts and media masterpieces to promote oral health. The key oral health messages to be included were provided. They were given full creative reign for this and encouraged to use any form of media they wished to enable maximum creativity and diverse range of masterpieces which can appeal to a wide range of audiences and students.

Results: RiY-SRFs demonstrated highest form of Participation continuum -structural participation3. Late-breaking results will be presented that describe the co-created winning entries and creative arts and social media masterpieces.

Conclusion: RiY-ESCALATOR has empowered student peer leaders who have demonstrated the ability to use creative arts and media to design and deliver oral health messages. Recommendations

were to implement these resources into RiY and assess their impact and effectiveness in improving oral health of students.

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99

Effect of cell derived decellularized Extracellular Matrix (dECM) on gelatin-based 3D bioprinted hydrogels

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Abstract

3D bioprinted hydrogels have emerged as the most advantageous potential technology to fabricate three-dimensional scaffolds with the same biomimetic architecture of tissue and organs. However, the thermal effects and mechanical stresses produced during the printing process could damage the encapsulated cells and reduce cell survival. The extracellular matrix (ECM) provides structural support, adhesive substrates and signalling cues that regulates cell growth. One successful approach to mimicking ECM, is through the decellularization of organs or tissues. As there is a shortage of organs/tissues available for this process, researchers are now focusing on an alternative method called cell-derived dECM. This study aims to investigate the effect of a scaffold comprising of cell derived dECM combined with gelatin-based 3D bio printed hydrogel; cell viability, hydrogel characteristics and cell specific Glycosaminoglycans (GAG) were examined. Human dermal fibroblasts were incorporated within the bioinks and 3D bioprinted hydrogel to create viable scaffolds. Structural changes of hydrogels were characterized by Raman spectrometry. Cell response was assessed with cell viability. GAG was measured by spectrophotometric assays. Results: cell derived dECM did not cause any effect on hydrogel structural changes, but it enhanced the cell viability up to day 6 and GAG content compared to control. Our results suggest DECM might have chondrogenic potential, but more assays are needed to strengthen results. Cell derived dECM has potential to have beneficial effects on gelatin-based 3D bio-printed hydrogels, increasing ability for tissue regeneration in bone and cartilage tissues. This approach could prove useful for creating a new generation of cell derived tissue grafts, relieving the need for tissue donor sources.

100

Mechanical, Physiochemical, and Bioactivity Testing of Liposomal Resin-Based Composite

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Abstract

Background:

38% of resin-based composite (RBC) restorations fail due to secondary caries (Opdam et al., 2007). Replacing RBC costs the NHS £300 million annually (Lynch and Wilson, 2013).

Liposomes (nano-phospholipid vesicles) drug-delivery system can encapsulate therapeutics with different solubilities (Laouini et al., 2012). Phospholipids, like phosphatidylserine can encourage hydroxyapatite formation (Merolli and Santin, 2009).

Liposomal drug-delivery was successfully applied in bone cement (Ayre et al., 2016). Data on its use in RBCs, however, is lacking. Therefore, this study aims to incorporate unloaded phosphatidylserine-liposomes into RBC to investigate the effect on the mechanical, physicochemical and hydroxyapatite forming properties.

Materials and Methods:

Filtek™ Z-250 universal RBC and phosphatidylserine were used. The liposomes were formed using thin film hydration and extrusion technique. Different concentrations of liposomes (1, 5 and 10mg) were incorporated into 1g of RBC.

For liposomal-RBC testing, 5 samples per concentration were prepared. The materials were tested to determine the strength of compression, diametral tension, bending and Vickers hardness. Samples were also tested using water-contact angle, water-sorption and Fourier transform infrared spectroscopy (FTIR). Samples were also incubated in simulated body fluid for 720h, and the ability to form hydroxyapatite was determined using scanning electron microscopy and X-ray diffraction.

Results:

Regarding the mechanical properties, water-contact angle and water-sorption, the liposomal-RBCs showed no statistical differences compared to the control RBC group (p>0.05). FTIR results

showed different intensities, however, the peaks were all similar, indicating no chemical changes due to the inclusion of liposomes.

Mineralisation data is currently being collected and analysed.

Conclusion:

Different concentrations of liposomal-RBC showed no significant effect on the mechanical and physiochemical properties. This work forms a baseline data to further explore the liposomal-RBC. Future work will focus on the ability of liposomal-RBC to encourage remineralisation. Also, the encapsulation efficacy, drug release and antibacterial properties of drug-loaded liposomes.

101

Investigating epithelial barrier function in the presence of bacterial pro-inflammatory stimuli using a novel organotypic oral mucosa model.

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Abstract

Periodontal disease remains a prevalent oral health concern, affecting nearly half of the adult population in the UK. The understanding and treatment of this condition are limited by the challenges associated with modelling oral mucosa *in vitro*. While animal studies have traditionally been utilised, ethical considerations and limitations in their physiological relevance have prompted alternative approaches.

In this study, we use a novel organotypic culture system aimed at generating an organotypic, stratified gingival epithelial model for *in vitro* applications. The system utilises a buoyant epithelial culture device (BECD) designed to house a collagen-based oral mucosal tissue equivalent, floating in culture media to maintain the culture at the air-liquid interface (ALI) and promote epithelial stratification. Here, we employ the BECD to investigate the inflammatory and barrier function responses of the oral squamous cell carcinoma cell lines H400 and VU40T to a bacteria-derived pro-inflammatory agent, lipopolysaccharide (LPS). The stratified structure of *in vitro* oral mucosa largely protected it from pro-inflammatory effects of LPS, only detected through increase of *CXCL8* gene expression. By comparison, a strong upregulation of not only *CXCL8* but also *IL6* and *IL11* was observed in monolayer cultures. Despite the limited pro-inflammatory response in the 3D model, a reduction of epithelial integrity was observed using transepithelial electrical resistance (TEER) assay, although without notable changes in expression of genes involved in epithelial barrier formation (*CDH1*, *OCLN*, *TJP1*, *TJP2*, *CLDN*, *JAM1* and *JAM3*). A comparison of basal gene expression between monolayer and organotypic cultures further revealed marked differences, with *IFNG* and *JAM3* being exclusively expressed in organotypic tissues.

These findings underscore the potential of the BECD model for oral mucosa modelling, particularly in the context of bacteria-induced inflammation, including periodontal disease. Future studies will focus on enhancing the physiological relevance of the system, incorporating primary gingival keratinocytes, and testing potential therapeutic interventions.

102

Development of immuno-competent organotypic oral mucosal equivalents

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Abstract

Current tissue engineered 3D *in vitro* models of oral mucosa equivalents (OME) feature a stratified epithelia and underlying connective tissue formed of gingival fibroblasts encapsulated in collagen hydrogels . These models lack the ability to examine innate immune response to bacterial, fungal, and other foreign body pathogens. Macrophages are key cells of the innate immune system that orchestrate an immune response to foreign body invasion, and are key effector cells in periodontal disease, gingivitis, and wound healing. Although presence of immune cells is critical in generating an immune response, to date very few OME models have incorporated an immune component, therefore the ability to mimic *in vivo* outcomes for inflammatory challenges is limited . In this study, we enhanced the tissue mimicry of previously developed organotypic air-liquid interface model (Hewitt et al., 2022) by introducing primary macrophages differentiated from peripheral blood monocytes. The developed immunocompetent OME was used to investigate tissue barrier integrity and immune response to bacterial challenge. The primary monocyte derived macrophages responded to bacterial lipopolysaccharide (LPS) challenge through upregulation of pro-inflammatory marker CCR7 and pro-inflammatory cytokines (TNF-α and IL-6). Moreover, it was observed that the pro-inflammatory immune response had an increased effect on barrier integrity compared to non-immunocompetent OME. The developed immune-competent OME showed functional activity, and could be used to study immune response to periodontal disease, wound healing, and oral cancer development and treatment.

References:

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103

Gene regulatory network in head and neck squamous cell carcinoma (HNSCC): implications for new therapies

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Abstract

HNSCC is the sixth most common cancer in the world, every year an estimated 650,000 new cases and over 350,000 deaths are reported. Most cases can be attributed to smoking and/or alcohol consumption whereas human papillomavirus (HPV) infection leads to approximately 25% of HNSCC cases. Over the last decade the genetic landscape of HNSCC has been extensively investigated. However, due to the heterogenic and dynamic nature of HNSCC tumours, the effectiveness of current therapies and the development of new therapies have been hindered.

Here we apply a combination of genome-wide methods, including DNase I-seq, ChIP-seq and RNA-seq to identify hypersensitive chromatin regions, transcription factor binding sites and gene expression levels, respectively. Together these methods allowed for identification of genome-wide regulatory elements relevant in HNSCC, highlighting potential HNSCC drivers and therapeutic targets.

DNase I hypersensitivity assay was conducted in five HNSCC cell lines, followed by transcription factor motif and gene ontology analyses, and compared to normal primary oral cells. The analyses revealed a common core regulatory network shared by both the HNSCC and normal cells and primarily driven by AP-1, p63 and TEAD4 transcription factors. This was confirmed by ChIP-seq and RNA-seq analyses which showed a major overlap between their binding, suggesting co-regulatory mechanisms involving EGFR, MAPK, TGFb and WNT/b-catenin pathways, previously found to promote HNSCC. In addition, the analyses highlighted an involvement of Hippo pathway and its transcription factor effector, TEAD4. Disruption of Hippo-driven gene transcription using Verteporfin reduced HNSCC cell viability and affected the regulation of genes involved in EGFR, TGFb and WNT regulatory pathways. Therefore, Hippo regulation appears to be required for epithelial function and holds potential to become deregulated, leading to HNSCC. We propose the Hippo pathway as a potential therapeutic target in HNSCC and postulate its role in affecting HNSCC-relevant pathways.

105

Comparative analysis of Heat-Killed Bacterial Challenges in 2D and 3D epithelial cell culture models: Evaluation of inflammatory cytokines.

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Abstract

Two-dimensional (2D) and three-dimensional (3D) cell culture models are widely used in *in vitro* tissue culture research. The behaviour of cells depends on the type of cell culture methods employed with 3D models becoming increasingly favoured over the commonly used 2D models as they more closely mimic the physiological conditions. Our research team has developed a 3D cell culture model based on Air-Liquid Interface (ALI), to obtain improved results for periodontal disease studies using Buoyant Epithelial Culture Device (BECD).

Periodontal diseases, such as gingivitis and periodontitis, are inflammatory conditions driven by a dysbiotic biofilm, including *Porphyromonas gingivalis, Streptococcus oralis and Fusobacterium nucleatum.*

To investigate inflammatory cytokine release, three cell lines (H400, 3T3, VU40T) were cultured using both 2D and ALI-3D cell culture models. Subsequently, each cell culture was challenged with heat-killed bacteria (*P. gingivalis, S. oralis, F. nucleatum*) or lipopolysaccharide (LPS). Enzyme-Linked Immunosorbent Assay (ELISA) and Transepithelial Electrical Resistance Measurement (TEER) assay were used to determine inflammatory cytokine production and epithelial barrier function.

The aim was to; understand the impact of cell culture models on the inflammatory cytokine release; analyse differences between heat-killed bacteria and LPS; and analyse the impact of bacterial challenges on the integrity of epithelium.

This study provides valuable insights into the selection of culture models for investigating inflammatory responses following cell stimulation. Furthermore, the results of this study will be the groundwork for investigating cell / bacterial interactions and the subsequent inflammatory response which is key to the initiation and propagation of periodontitis.

106

Introducing bioactivity to polyether-ether-ketone (PEEK) with bioactive glass for use as an implant material

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Abstract

Objective: To introduce bioactivity to polyether-ether-ketone (PEEK), an inert polymer, by coating it with bioactive glass, using a grit blasting technique. This will potentially improve the implant material's osseointegration with bone.

Methods: The preliminary study involved BioMinF glass abrading the length of rectangular PEEK samples (Goodfellow, UK, 20 x 10 x 2 mm^3; n=6 per test) either twice or 12 times using the air abrasion instrument (Aquacare) - grit blast technique. Conditions included air abrasion handpiece at a distance of 3 mm, a velocity of 0.5 mm/sec, and either a high pressure of 4 bars or low pressure of 0.5 bars, The samples were then immersed in individual bottles containing tris-buffer solution (10 ml) or simulated body fluid (SBF, 10 ml) for seven days. The samples were characterized using FTIR, XRD and SEM-EDX, before and after abrasion, and after 7 days of immersion. These techniques were also used to analyze BioMinF alone.

Results: BioMinF showed an amorphous structure (XRD). The FTIR of PEEK samples following air abrasion at low pressure with BioMinF and following immersion in both solutions, showed evidence of surface alteration. Air abrading at high pressure showed no evidence of surface alteration. The results of SEM-EDX confirmed that there was glass embedded in the PEEK samples and possible apatite formation at low pressure. Interestingly at high pressure there appeared to be more glass embedded in PEEK's surface and apatite formation. PEEK samples prior to air abrasion and abrading twice followed by immersion in either solution showed no evidence of embedded glass.

Conclusions: These interesting results confirmed that air abrading PEEK samples (12 times), at low and high pressure, with bioactive glass particles altered PEEK's surface. SEM-EDX confirmed that there was glass embedded in the PEEK samples and possible apatite formation.

107

Development of tunable hydrogels to mimick mechanical properties of gum tissue for in vitro implant-soft tissue attachment studies.

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Abstract

Introduction: Collagen type I serves as the primary constituent of the extracellular matrix in skin-like structures and is extensively employed as a natural polymer in 3D oral mucosa models (OMMs). However, insufficient tensile strength and susceptibility to shrinkage undermine collagen's fidelity in replicating the intricate gingival architecture. This study introduces alginate and GelMA(Gelatin methacryloyl) into the *in vitro* OMMs to bolster their mechanical properties. This augmentation not only offers tunable mechanical properties but also facilitates real-time monitoring of cellular proliferation due to decreased opacity .

Methodology: The mechanical properties and biocompatibility were investigated for Alginate-collagen and GelMA-collagen hydrogel formulations. Alginate and GelMa were crosslinked with $CaCl_2$ and lithium phenyl-2,4,6-trimethylbenzoylphosphinate (LAP), respectively. Alginate:collagen ratios of 1:1 and 1:2 using alginate solution with pH 6.5 and pH 7.4, together with GelMA:collagen ratios of 2:1, 1:1 and 1:2 were investigated. The mechanical properties of the hydrogels were characterized using the HR-1 Discovery Hybrid rheometer and the ElectroForce 5500 test instrument. The biocompatibility was tested by encapsulating 3T3 fibroblasts and surface seeding of VU40T keratinocytes, followed by viability assays and Confocal Laser Scanning Microscopy (CLSM). The formation of mono- and stratified epithelial layers was assessed via H&E staining at 8 and 21 days post-seeding.

Results & Conclusion: The stiffness of all tested hydrogels exhibited similarities to porcine gum tissue, substantiating its potential for mimicking gingival tissue. However, only GelMA-collagen formulation with 1:2 ratio demonstrated notable biocompatibility and facilitated the successful formation of stratified epithelial layers. In contrast, alginate-collagen scaffold with a pH 7.4 and a ratio of 1:2, although exhibited optimal fibroblast cell proliferation and morphological changes, did not support epithelial stratification with keratinocytes aggregating on the hydrogel surface instead.

Consequently, this approach enables the engineering of 3D models capable of recapitulating the mechanical and biological characteristics akin to porcine gum tissue.

108

Reliability of zirconia monolithic crowns: effect of the CAD/CAM milling protocol

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Abstract

Although recent improvements in the CAD/CAM technology allowed for more personalized treatments, it is not clear how the modifications in the CAD/CAM milling process could affect the restoration surface conditions and their mechanical behavior. The objective of this study was to evaluate the effect of different CAD/CAM milling protocols on the topography and fracture behavior of zirconia monolithic crowns (3Y-PSZ) subjected to a chewing simulation. Monolithic 3Y-PSZ premolar crowns were CAD/CAM milled using three protocols (n = 13) (smooth (S), normal (N), fast (F)). Crowns were cemented on a dentin analog abutment and subjected to mechanical aging (200 N, 2 Hz, 1,500,000 cycles, 37°C water). Surviving crowns were subjected to compressive load test and analyzed using fractography. Fracture load data were analyzed with two-parameter Weibull analysis. The surface topography of the crowns was examined with stereomicroscope and 3D non-contact profiler. All crowns survived the chewing simulation. Crowns milled with the Fast protocol had the greatest characteristic fracture load, while crowns produced with the Smooth protocol showed high Weibull modulus. Groups N and S have a more homogeneous surface and detailed occlusal anatomy than group F. The CAD/CAM milling protocol affected the topography, reliability, and fracture resistance of 3Y-PSZ monolithic crowns.

109

Hydrophobic interaction of statherin from various origins on hydroxyapatite(HAP)

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Abstract

Objective: To explore hydrophobic interaction of statherin from different origins (parotid saliva, PSa; unstimulated whole mouth saliva, uWMS; synthetic phosphorylated statherin) on HAP and hydrophobic particles.

Methods: 40ug/ml synthetic statherin (±phosphorylation) dissolved in three pH buffers (3/4.2/7) and PSa diluted in two pH buffers (3.6/7) were incubated with Polystyrene particles (PS, hydrophobic surface) respectively. After incubation, proteins bound were eluted by TBST (tris buffered saline with tween 20) and EDTA. Electrophoretic analysis of the density of these statherin bands from eluents were quantified. Plus, 0.5ml PSa, uWMS and 40ug/ml synthetic phosphorylated statherin solution were incubated with HAP discs and PS particles, respectively. Proteins bound were eluted and quantified similarly as previously after calibrations of concentrations of statherin in three origins. Statherin amounts eluted by TBST and EDTA were immunoblotted by anti-statherin antibody. Two-way ANOVA and Kruskal-Wallis H test were used for PS particles and HAP analysis, respectively.

Results: On PS particles, synthetic phosphorylated statherin in neutral buffer reduced significantly compared to acidic buffers ($p<0.05$) which were not seen in non-phosphorylated synthetic statherin. However, statherin bound from PSa showed a significantly increase in neutral buffer compared to acidic buffer ($p<0.05$). For different origins of statherin on PS particles, the adsorption of salivary statherin decreased significantly than synthetic phosphorylated type ($p<0.05$). When on HAP, the adsorption of synthetic and uWMS-derived statherin were similar which was statistically higher than that from PSa ($p<0.05$). For Western Blot analysis, the amount of statherin bound on HAP in all three origins eluted by TBST and EDTA were similar.

Conclusion: Compared to synthetic statherin, hydrophobic interaction of salivary statherin, especially from PSa, was inhibited significantly on HAP. Plus, hydrophobic interaction is as vital as electrostatic interaction for the binding of statherin on HAP, which may be adjusted by the protonation of phosphate groups of statherin.

111

RiY ESCALATOR - RAISED in Yorkshire teenager citizEn SCientists addressing orAL heAlth equaliTy & behaviOuRal change - Qualitative findings

Yasmen Elsadek, Karen Vinall-Collier, Julia Csikar, Sue Pavitt

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Abstract

Background: Schools have long been proposed as an opportune entry point for general and oral health interventions. Henceforth, appropriately designed school-based interventions using a peer-to-peer delivery approach are proposed to positively influence both peer-leaders' and peer-recipient outcomes showing bidirectional gain[1].

RAISED in Yorkshire (RiY) is a peer-to-peer citizen science oral health programme that trains 16-18-year-old-students from underserved communities as 'RiY-Student Research Fellows' (RiY-SRFs) to deliver peer-led oral health promotion to 11-12-year-old-pupils. This novel peer-to peer delivery approach relies on shared cultural backgrounds and relatability to reach students who may be missed by typical health professional-led intervention. The gain for RiY-SRFs has not previously been explored.

Aim: To explore the gain for RiY-SRFs from participation in RiY and the impact of the programme on their career aspirations and choices.

Method: All current RiY-SRFs (across five schools/colleges in Yorkshire) were invited to take part in focus group discussions after their training and respective delivery of RiY intervention to 11-12-year-old-students at their school. Those who had previously undertaken a role as RiY-SRF since 2016 were also invited to undertake a semi-structured interview with the researcher. These explored the potential benefits of RiY and obtained feedback for improvement. Thematic analysis was carried out according to the recommendations of Braun & Clarke.[2]

Results: Thirty-seven out of 48 current RiY-SRFs (77%) consented to participate in seven focus group discussions (ranging-18-44 mins). RiY-SRFs reported many benefits from participation, common themes included: interpersonal skills enhancement; public health awareness; citizen science involvement; work experience; and they were keen to explore opportunities for more co-production and co-delivery. Alumni interview (29mins) described RiY participation as pivotal in strengthening university applications and guiding career choices.

Conclusion: RiY provides bi-directional gain embedding invaluable work experience for RiY-SRFs, contributing to widening participation. RiY-SRFs have instigated developing meaningful oral health promotion arts and social media outputs to deliver to their peers (See Elsadek-abstract #98). RiY-Alumni

from underserved communities demonstrated success in studying dentistry, graduating as dentists, and working back in their community helping address access issues.

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112

Efficacy of a fluoride toothpaste containing 67% Sodium Bicarbonate for plaque reduction and management of gingivitis: A 12 week randomized controlled clinical study

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Abstract

Oral diseases affect approximately 3.5 billion people worldwide. Gingivitis develops as response to dental plaque accumulation and can be prevented and resolved through effective mechanical twice daily plaque removal. If left untreated, gingivitis can progress to periodontitis. Sodium bicarbonate ($NaCHO_3$) toothpastes have been shown to enhance plaque removal and improve gingival health following professional cleaning (prophylaxis). However, it id clinically relevant to investigate the efficacy in sufferers of mild gingivitis without initial dental prophylaxis.

This was a single center, controlled, examiner blind, randomized, two treatment arm, parallel study in healthy volunteers with clinically measurable levels of gingivitis (10 - 30% bleeding sites and probing pocket depth of ≤3 mm following Updated Classification of Periodontal health. The study investigated the efficacy of a toothpaste containing 67% w/w $NaHCO_3$ and 0.310% w/w sodium fluoride compared to a regular fluoride toothpaste. Study participants did not receive dental prophylaxis before commencing study. Gingivitis was assessed by Number of Bleeding Sites (NBS), Bleeding Index (BI), Modified Gingival Index (MGI) and Turesky Plaque Index (TPI) at Baseline, 3, 6 and 12 weeks following twice daily brushing.

A total of 190 subjects were randomized and 188 completed the study. 67% $NaHCO_3$ demonstrated statistically significant improvements in mild gingivitis and plaque reduction as measured by NBS ($p=0.0032$), BI ($p<0.0001$), MGI ($p<0.0001$) and TPI ($p<0.0001$), also compared to negative control in NBS ($p=0.0013$), BI ($p=0.0022$), MGI ($p<0.0001$) and TPI ($p<0.0001$) at week 12. Significant differences were also found at 3 and 6 weeks (except 6w NBS change from baseline, $p=0.0541$). No treatment-related adverse events were reported.

This study demonstrated that 12 weeks twice daily use of a therapeutic toothpaste containing 67% $NaHCO_3$ significantly reduces plaque scores and improves mild gingivitis, as early as 3 weeks, in subjects that did not receive a dental prophylaxis which better reflects consumers behaviours.

113

Exploring Epigenetic Processes in Oral Epithelial Dysplasia and Early Invasive Carcinoma: Using Tissue-Engineered Models for Epigenomic Analysis

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Abstract

Background: Oral potentially malignant lesions (OPML) present as white or red lesions with histological changes. Around 9-33% may progress to oral cancer. UK oral cancer cases rose by 58% in a decade, with 200,000 OPML referrals in 2020, resulting in 8,722 cancer diagnoses. Molecular mechanisms behind OPML development and progression to cancer are poorly understood. Current research often uses monolayer cell cultures, which do not accurately mimic the in vivo environment. Our goal was to validate tissue-engineered mucosal constructs as a tool in defining key molecular events involved in cancer progression.

Methods: Keratinocytes from normal, dysplastic, and OSCC were used to create full-thickness tissue-engineered models, which were validated against native tissue. Next-generation RNA sequencing and DNA methylation profiling were employed to detect genes with differential expression and methylation patterns. Bioinformatics analysis was performed to assess gene set pathways and identified genes of interest. Validation was carried out using Sanger sequencing and qPCR, while the hypomethylating agent decitabine was examined for its potential to restore gene function.

Results: The tissue-engineered constructs closely resembled native tissue, with dysplastic models exhibiting disorganized epithelial architecture and cellular atypia. RNA and DNA methylation sequencing revealed 1070 downregulated and 1907 upregulated genes, and 1209 hypermethylated and 1791 hypomethylated promoter regions in dysplastic models compared to normal. Integration analysis identified 59 genes downregulated and hypermethylated, associated with key pathways including choline metabolism, p53 signaling, antigen processing, and cytokine signaling. Decitabine effectively restored function of specific tumour suppressor genes in the dysplastic model.

Conclusion: The study demonstrates the reliability of tissue-engineered models in reproducing cancer progression in vitro. Dysplastic models showed significant molecular alterations associated with oral cancer progression. These findings may offer insights for developing therapeutic targets to improve outcomes for early-stage OSCC patients.

114

Characterisation of Tryptophan-Kynurenine Pathway Metabolites in Post-traumatic Trigeminal Neuropathic Pain Development

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Abstract

Introduction: Post-traumatic trigeminal neuropathic pain (PTTNp) is a persistent painful condition with a complex pathophysiology. Pulpitis-induced nociplastic changes might play a role. Kynurenine (KYN) pathway is the majorcatabolic route for Tryptophan (Trp), contributing to several neuroactive compounds, including kynurenic acid (KYNA), anthranilic acid (AA), quinolinic acid (QA), and picolinic acid (PIC), which are linked to persistent pain. However, these metabolites remain unexplored within pulp tissue. Our hypothesis is KYN metabolites are increased in pulpitis, potentially contributing to PTTNp.

Aim: To investigate the correlation between KYN metabolites during pulpitis to examine any role in the development of PTTNp.

Methods: 10 healthy control and 10 symptomatic irreversible pulpitis tooth samples were collected at Newcastle Dental Hospital. Liquid chromatography-mass spectrometry was employed to quantify the concentration of Trp and KYN metabolites within the tissue. Mann-Whitney test and independent t-test were used to compare the two group's metabolites.

Results: Trp concentration increased in the pulpitis group (Median 33.74 nM/mg tissue) compared to healthy (Median 10.62 nM/mg tissue, $p = 0.0015$). The tissue Trp/KYN ratio was sixfold higher in the pulpitis group (16.11 ± 13.47) than the healthy group (2.68 ± 1.4, $p = 0.0117$). No significant difference was observed for KYN between the two groups ($p = 0.0892$). KYNA, QA, and PIC concentrations were elevated in the pulpitis group, but undetected in the healthy group, whilst AA was undetectable in both.

Conclusions: Symptomatic irreversible pulpitis is associated with an increased concentration of KYN metabolites, suggesting they may represent potential biomarkers or therapeutic targets for PTTNp.

115

Investigating New Resin System for Regenerative Dental Application

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Abstract

Introduction: Monomer resins have been widely used in dentistry as they exhibit several advantages including high mechanical strength, ability to be cured immediately and adhesion to other restorative materials. However, most were reported to inhibit cell growth and potentiate cell death. Therefore, there is a clinical need for biocompatible monomers.

Aim: The aim of the study is to investigate the physical properties and biological effects of new resin system for regenerative dental application.

Materials and Method: New tested resin system was investigated and compared to methacrylate resin model. Energy Dispersive Spectroscopic (EDS) qualitative analysis was conducted for unfilled cured discs in various selected areas. Water sorption and solubility testing was performed following: ISO 4049:2019-05 for testing polymer-based restorative material. Fourier transform infrared spectroscopy combined with micro-attenuated total reflectance crystal was used to evaluate the real time degree of conversion (DC) of the tested resins. Cell-counting kit-8 (CCK-8) was used to assess the viability of human mesenchymal stem cells (hMSC) when contacted with tested resins in cell culture for 3 days. Scanningelectron microscopy (SEM) was performed to evaluate the morphology of hMSC after they were placed in contact with resin discs.

Results: The new resin showed significantly higher viable cells than methacrylate resin ($p < 0.05$). SEM images showed that hMSCs formed a well-attached cell layer over the new resin discs.

Conclusion: The new tested resin has a favorable biological effect and could be a potential resin used for regenerative dentistry.

116

Prevalence, onset and severity of oral manifestations in pemphigus vulgaris and paraneoplastic pemphigus

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Abstract

Purpose

Pemphigus is an autoimmune bullous skin disorder, a potentially life-threatening condition. If this disease is diagnosed early, its mortality can be reduced. This review aims to identify the characteristics of one of the early manifestations of the disease, the oral lesions, and to identify its prevalence and onset during the disease.

Methods

A systematic review of primary studies on the oral manifestations of pemphigus vulgaris (PV) and paraneoplastic pemphigus (PNP), during the period from January 2000 to December 2022, was carried out. The search was performed according to a pre-decided inclusion criteria followed by a critical appraisal of the included studies using the Joanna Briggs tool.

Results

Out of the 1551 studies identified, only 25 fulfilled the inclusion criteria. In the case of PV, subjects with oral mucosa as the only initial manifestation of the disease were present in 95% of studies. Whereas in 47.8% of studies, all the subjects had oral lesion at least once in the whole disease period. As for PNP, in one study, 91.7% of subjects had oral lesion at the onset of the disease.

Conclusions

Even though PV and PNP are primarily dermatological disorders, oral lesions are common manifestation of the disease. Most of these lesions occur at the initial stages as the first symptom. A standardized scoring system is needed to monitor disease severity. Training general medical and dental practitioners to identify these lesions at an early stage is also required for the prompt and timely management of the disease.

117

SARS-CoV-2 viral structural protein can directly disrupt oral mucosa epithelium integrity and differentiation

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Abstract

Most of the COVID-19 patients share common clinical oral manifestations including oral mucosa lesions, and periodontal symptoms etc. The pathological and molecular mechanisms about how oral mucosa epithelium, the protecting barrier of oral cavity are affected by COVID-19 are still unknown. Our group is endeavour to elucidate the cellular and molecular etiology of COVID-19 on oral health. In this study, we found that SARS-CoV-2 can attack oral mucosa epithelium integrity directly. Using ex vivo mouse tongue organ culture and 3D human oral mucosa equivalent models, as well as an oral epithelial cell line, we conducted a series of biochemical and molecular analysis, together with functional tests. We confirm that SARS-CoV-2's structural protein can directly affect oral epithelial cell-cell junction maintenance by disturbing the expression of key molecules and disrupting oral epithelial differentiation program and cell cycles. Our results therefore provide novel evidence of how the SARS-CoV-2 virus can affect oral epithelial cell fate and oral mucosa integrity. The mechanisms identified can be extended to the other organs and symptoms hence potentially will provide novel therapeutic targets for COVID-19.

118

A monotonal load-to-fracture test for a minimally invasive posterior ceramic restoration bonded with dentine-analogue material

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Abstract

Objectives: To compare the maximum loading capacity and fractographic features between occlusal veneers milled from two commercial CAD/CAM materials (lithium disilicate and zirconia-reinforced lithium silicate) bonded to dentine analogues.

Methods: Master dies made of high-strength PMMA from a typodont mandibular first molar with minimal tooth preparation were digitally scanned (E4, 3Shape A/S) to produce tooth analogues (n=30) from high-pressure fibreglass laminate (NEMA-G10). Occlusal veneers (1-mm thick) were made from two materials (n=15 each): (1) LD - IPS e.max®CAD (Ivoclar Vivadent) and (2) ZLS - Celtra®Duo (Dentsply Sirona). They were cemented with dual-cured resin cement and allowed to fully cure in distilled water for 48 hours at 37 ℃. Each test specimen was then placed in a universal testing machine and loaded via a non-fixed 5.5 mm stainless-steel ball that allowed some lateral freedom of movement at the rate of 1 mm/min until the restoration fractured. The restorations were inspected under optical and high-resolution microscopy. The maximum loads (N) were determined and statistically compared using a two-sample t-test and Weibull statistical analysis.

Results: The mean values of the maximum load of the restorations made from ZLS were not statistically different from the LD group ($p \geq 0.05$). The scale parameter or characteristics strength (σ) of the ZLS was slightly lower than the LD group. However, the shape parameter or Weibull modulus (m) of the ZLS was almost two-and-a-half-fold greater than the LD group, implying that the material may possess fewer intrinsic defects. Differences in fragment sizes between the two materials were noticed from the high-resolution microscopy.

Conclusions: The fracture resistance of occlusal veneers made from Celtra Duo is not superior to that of IPS e.max CAD. However, Celtra Duo has a narrow fracture strength distribution and is less likely to fail before the expected loading values.

Keywords: lithium disilicate, load-to-fracture test, minimally invasive dentistry, occlusal veneers, zirconia-reinforced lithium silicate

119

General population preferences for dental care outcomes: Results from two discrete choice experiments

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Abstract

Objectives: To elicit and value patient preferences for high dose prescription fluoride toothpaste and associated dental health outcomes

Methods: An online discrete choice experiment survey with a nationally representative sample of the UK general population was used to elicit preferences for different types of toothpaste, sustainably produced toothpaste and dental health outcomes (avoidance of early, moderate and severe decay). We explored the impact of whether affected teeth were visible or not on preferences for outcomes. An experimental design generated 36 choice tasks, split into four blocks of 9, meaning each respondent answered 9 choice tasks to minimise respondent burden. Preferences were analysed using error components logistical regression modelling. A cost attribute was included in the DCE to enable calculation of willingness to pay to value different outcomes.

Results: N=1200 respondents completed the full DCE. Respondents valued, and were willing to pay £50.22 per year (approximately £4.19 per tube) for prescription strength high-dose fluoride toothpaste. Willingness to pay increases by £1.70 per tube where the toothpaste is developed sustainably, in line with net zero targets. Participants highly valued avoidance of extractions and were willing to pay £327.89 and £263.03 per year over 3 years for the avoidance of extraction of a front and back tooth respectively. Similarly high values were observed for the avoidance of severe decay that might require root canal or crown treatments. Avoidance of moderate decay requiring a filling was valued at £56.49 and £144.85 per year for three years for a back and front tooth respectively.

Conclusion: Our DCE demonstrates that the general population place substantial value on the avoidance of decay related outcomes, particularly those that require root canal or extraction. Avoidance of treatment on front, visible teeth was valued more highly than avoidance of decay on back teeth, suggesting a strong aesthetic component to valuations.

120

Tau plays an essential role in periodontal ligament ageing

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Abstract

Tooth loss and edentulism are among the ten leading causes affecting the aged populations. Preservation of a tooth relies heavily on healthy periodontal ligament tissues. Similarly, successful dental implants and tooth restoration processes also depend on functionally restored periodontal ligament. Tau is a neuronal microtubule associated protein whose main biological functions are to promote microtubule self-assembly by tubulin and to stabilize those already formed. In this study, we provide the first evidence that Tau is an important molecule that is connected with periodontal ligament fibroblast ageing. Using human and mouse tooth samples, as well as a human periodontal fibroblast cell line, we proved that Tau expression is significantly altered in aged tissues, comparing to the young ones. Tau isoform expression, as well as its phosphorylated form were associated ageing and senescence. Biochemically, overexpression or down-regulation of Tau using shRNA, siRNA or retroviral expression systems could affect fibroblasts cell fate directly. Functionally, disrupted Tau expression could also affect wound healing on a two-dimensional periodontal wound model. Our results therefore suggest that Tau can be potentially used as a biomarker for human periodontal ageing and health status monitoring and can provide new therapeutic targets for tackling oral frailty.

121

The usefulness of indirect immunofluorescence test in monitoring treatment success in Pemphigus Vulgaris

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Abstract

Purpose

Indirect Immunofluorescent (IIF) can potentially help in diagnosing and monitoring Pemphigus Vulgaris (PV). This study aims to evaluate the current evidence to reach conclusion on the usefulness of IIF as a monitoring test for disease activity.

Methods

A systematic review was performed by searching different electronic databases such as PubMed, Google Scholar and Science Direct. Inclusion and exclusion criteria were applied to include the relevant studies. A quality assessment of the selected studies was conducted using Joanna Briggs Institute (JBI) critical appraisal tools.

Results

Six papers were included in this systematic review, four case series and two case reports. The case reports of Yano et al. (2000), Avgerinou et al (2013), Bellon et al. (2014) and Nakahara et al. (2014) described correlation between IIF and disease activity. While Aksu et al. (2010) reported that IIF titres did not decrease as quick as the clinical improvement. Similarly, Weiss et al. (2015) reported no correlation between IIF titres and disease activity.

Conclusion

This systematic review gathered information concerning IIF and PV clinical disease activity. IIF is a tool to monitor disease activity, but clinical experience of clinician is much more important as the laboratory test cannot replace it as a standardised method of disease activity monitoring. More powered diagnostic studies need to be conducted to compare clinical diagnosis and monitoring PV activity to IIF and other tests, such as enzyme-linked immunosorbent assay (ELISA), using standardised research methodology to allow metanalysis.

122

Unveiling the Impact of Boric Oxide (B_2O_3) on Barium Fluormica Crystallisation: A Machinable Glass-Ceramic for Dental CAD/CAM Applications.

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Abstract

The widespread adoption of CAD/CAM technologies in modern dentistry underscores the necessity of choosing highly machinable materials suitable for chairside use. Most machinable glass ceramic require expensive diamond tipped tooling to undertake the machining process. Many dental glass ceramics are so hard that they can't be machined in their final form. This adds to the costs and complexity to the CAD/CAM process. Fluormica glass ceramics can be machined with hardened steel tooling. This is due to their unique "House of Cards" (HOC) microstructure. The development of barium fluormica glass ceramics has yielded promising results in terms of their mechanical properties for dental applications. The incorporation of (B_2O_3) into the glass matrix of mica glass-ceramics significantly influences the formation of barium fluorphlogopite crystals. Thus, the primary objective of the study is to investigate the effect of boric oxide (B_2O_3) on the crystallisation and microstructure of barium fluormica glass ceramics. Three barium-based glasses with varying B_2O_3concentrations were characterised using differential scanning calorimetry (DSC), X-ray diffraction (XRD), Vickers microhardness, and Scanning electron microscopy (SEM). The DSC results indicate that increasing boric oxide concentration decreases the glass transition temperature (Tg). XRD analysis confirms barium fluorphlogopite crystallisation with minimal secondary phases. Vickers microhardness shows a gradual decrease in hardness with increasing heat treatment temperature. The hardness reduced from > 6GPa for the glass to < 2.8GPa for the glass ceramic. The higher boron containing glasses formed the HOC microstructure associated with low hardness values. This demonstrates the importance of understanding composition-structure-property relationship in barium-based mica glass ceramics for CAD/CAM dental applications.

124

Dental screening and fluoride varnish/SDF application of children and young people accessing a community foodbank.

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Abstract

Background

Community support hubs are attended by the most vulnerable in society with known barriers to engaging with regular healthcare services e.g., travel, language, costs. The aim of this study was to screen children/young people attending a community foodbank.

Methods

Favourable ethical opinion was obtained. Families with children aged 0-16, attending Newcastle foodbank, were offered a dental check and application of fluoride varnish/silver diamine fluoride (SDF) over a 5-day period. Written parental consent, and verbal assent, were obtained. Data collected included: demographics; self-reported oral-health-related-quality-of-life (OHRQOL); DMFT/dmft ICDAS limited to D_3-D_6; presence of PUFA. A single dentist was trained and calibrated to the BASCD epidemiology screening toolkit. Intra-rater reliability was Kappa Statistic, 0.87. Descriptive statistics were applied.

Results

One-hundred and forty-one children were screened, summary demographics were: mean age 6.4 years (SD 3.8); gender female (52.5%); ethnicity 36.2% white, 33.3% black, 15.6% Asian.

Self-reported oral health was mostly good (39.4%) or fair/poor (32.1%) with 80.3% reporting no impact on their OHRQOL; however, 13.1% reported some to very much impact. Mean dmft was 1.7 (SD 2.9; 0-15), DMFT was 0.3 (SD 0.9; 0-4), combined dmft/DMFT was 2.0 (SD 3.1; 0-19).

Fifteen patients received SDF, 125 fluoride varnish and one declined. Two children had abscesses, two pulpal involvement and one sinus/ulceration. Children requiring treatment were signposted to local services.

Discussion

Extent of dental disease was lower than expected; however, consistent with regional and national rates. Most were in the primary/early mixed dentition likely reflecting the lower DMFT score. Encouragingly, 10.6% of children had definitive treatment with SDF , potentially negating the need for dental extractions. Engaging with the foodbank provided a unique opportunity to provide care for vulnerable children. Working with community support hubs has important policy implications to addressing the wider determinants of health inequalities.

126

Flexural strength and bioactivity of two experimental composites functionalised with low-sodium vs. high-sodium bioactive glass filler.

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Abstract

Bioactive glasses (BAGs) are incorporated into restorative dental composites to promote remineralization, improve marginal integrity, and potentially increase the longevity of composite restorations. However, conventional Bioglass composition contains relatively high levels of sodium (24.5%). Due to the high affinity of sodium for water, this may lead to high water sorption, which compromises the mechanical properties of the restorative material overtime. This study aims to: 1- Create and optimise a low-sodium BAG composite alternative. 2- Evaluate the flexural strength, bioactivity of this low-sodium composite vs. a high-sodium comparator to detect the effects of varying sodium levels. Two experimental compositions (G6 and G6-Na) BAG composites were created, and characterised using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and ion release studies. Standardised composite bars were created and immersed in artificial saliva pH=4 (AS4) and artificial saliva pH=7 (AS7) and the flexural strength was evaluated at Baseline, 0 days (Dry), 1 day, 14 days, and 30 days after immersion. The composites were also used to restore extracted teeth with natural caries (ICDAS II score 4 or 5) and scanned with X-ray microtomography (XMT) at timepoints up to 3 months. Flexural strength results showed a significant drop in G6-Na group after 1 month immersion in AS4 (75.82 ± 9.88 to 16.98 ± 3.61 MPa) while G6 group maintained higher flexural strength results after immersion (81.26 ± 13.55 to 56.47 ±7.39 MPa). A similar pattern was seen after immersion in AS7 but to a lesser extent. XMT scans and Ion release studies confirmed bioactivity and signs of remineralisation for both compositions. This demonstrates the importance of understanding composition-performance relationships and factors affecting the rate of degradation in bioactive glass containing dental composites.

128

Evaluation of Smartphone-Captured Intraoral Photographs for Detection of Intraoral Problems: A Diagnostic Accuracy and Feasibility Study

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Abstract

Introduction: Oral health disparities, particularly in regions with limited dental services, significantly impact global health. Despite its potential, the adoption of teledentistry using smartphone-captured intraoral photographs has been slower than other telemedicine technologies. This scoping review evaluates the diagnostic accuracy and feasibility of smartphone-captured intraoral photographs for detection of oral conditions, highlighting existing research gaps, and proposing direction for future studies.

Methods: Following Joanna Briggs Institute guidelines, articles published from 2014 to the present were searched, sourced from MEDLINE Ovid, Web of Science, and Google Scholar. English-language studies evaluating the accuracy and the feasibility of smartphone-captured intraoral photographs were included. Two reviewers independently screened the titles, abstracts, and full texts. Data on camera specifications, diagnosed conditions, reference standards, performance metrics, feasibility, and outcomes were extracted and synthesised.

Results: 36 studies met the inclusion criteria. Diverse practices in capturing intraoral images were identified, including use of macro lenses, retractors or external lighting to enhance image quality. Conditions assessed, included dental caries (n=16), periodontal diseases (n=5), and oral cancers (n=10). Sensitivity and specificity ranged from 40% to 95%, and 60% to 100%, respectively. Feasibility assessments revealed significant variations in the time required to capture images, ranging from 30 seconds to 3 minutes. Challenges in achieving consistent image quality were noted, but smartphone photography was generally well-received and comparable to traditional methods. Image capture protocols were rarely evidence-based, thus substantial methodological disparities were identified. Reports on the number of attempts required to capture valid photographs and techniques to enhance image clarity were sporadically mentioned. Limited evidence on paediatric applications was also observed.

Conclusion: Smartphone-based teledentistry demonstrates substantial potential for enhancing oral health diagnostics in underserved areas. However, the research underscores a need for more rigorous and standardised methodologies to fully harness these technologies for clinical application.

Review Registration Number: Open Science Framework https://osf.io.f9hv8.

129

Analysis of Tricalcium Silicate Sealers on Modified Dentine

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Abstract

Aim: To investigate the effect of irrigation protocols on the dentine microstructure and assess the interaction of tricalcium silicate sealers with the modified dentine.

Methodology: Single rooted extracted teeth were subjected to various irrigation protocols with NaOCl, EDTA, and DMSO. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) were employed to evaluate the dentine microstructure and composition. Fourier transform infrared spectroscopy (FT-IR) analysed compositional changes in dentine after different irrigation protocols. The canals after irrigation were filled with AH Plus and tricalcium silicate cement (TCS) - BioRoot RCS, BioRoot Flow, and AH Bioceramic. SEM, EDS, and FTIR Microscopy examined the material-to-tooth interface. Statistical analysis included ANOVA with Tukey post-hoc tests and the Kruskal-Wallis test.

Results: EDS analysis detected calcium, phosphate, silicon, and zirconium in all samples on irrigation and obturation, with FTIR revealing carbonate, phosphate, and amide content. SEM images showed a denser smear layer with NaOCl and DMSO when used on their own. EDTA and DMSO used as final wash after NaOCl-EDTA widened dentinal tubules, but usage of EDTA caused cracks and erosion. AH Plus showed better marginal adaptation with EDTA. Adequate adaptation occurred with AH Plus Bioceramic and BioRoot Flow sealer with DMSO irrigation, but not with AH Plus and BioRoot Flow. TCS sealers effectively penetrated dentine without EDTA, unlike AH Plus. TCS sealers significantly increased calcium levels compared to AH Plus ($p < 0.05$). DMSO irrigation and AH Plus Bioceramic obturation led to the lowest calcium levels ($p < 0.05$). Silicon deposition was highest with DMSO irrigation and AH Plus Bioceramic obturation ($p < 0.05$). NaOCl-EDTA-DMSO retained the highest amide/phosphate content ($p < 0.05$) compared to NaOCl-EDTA-EDTA.

Conclusion: TCS sealers demonstrated satisfactory marginal adaptation even in the absence of a chelator. The incorporation of DMSO shows potential in dentine to tooth adaptability.

132

Polyamide denture-base materials have lower mechanical properties and absorb more water than PMMA

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Abstract

Title: Polyamide denture-base materials have lower mechanical properties and absorb more water than PMMA

Purpose: This study aimed to compare the mechanical properties of polyamide-based, injection-molded denture base materials (Valplast, Deflex, and Vertex Thermosens) with a conventional compression-molded PMMA (Pegasus Plus).

Materials and Methods: Flexural properties, nano-hardness, and water sorption of denture base materials were evaluated (n=5) after water storage at 37°C up to 30-days. Bar-shaped specimens (70×10×3.5mm) were used to evaluate the flexural properties and disc-shaped specimens (19.5×3.3mm) were used to evaluate the nano-hardness with analysis conducted after storage for 0, 1, 7, and 30 days. Water sorption was measured daily for 7 days and then weekly for up to 30days using disc-shaped specimens (4×2mm). Data were analyzed using ANCOVA, followed by Tukey post-hoc test (α=0.05)

Result: PMMA specimens were stronger (range 83-102MPa) had a higher modulus (range 0.8-1.2GPa) and were harder (15-21VHN) than the polyamide specimens at all time points (P<0.001). While there were no differences between Deflex and Vertex Thermosens specimens, the Valplast specimens were significantly weaker (range 43-51MPa) more flexible (range 0.3-0.4GPa) and softer (range 6-8VHN) than all materials (P<0.001).

By day 30, the Deflex and VertexThermosens specimens had absorbed over 2% water, significantly more than PMMA specimens (1.34, P<0.001), with Valplast specimens absorbing the least (0.79, P<0.001)

Conclusion: The lower mechanical properties of the polyamide materials mean they are suggested only to be used for partial dentures and certain cases. While Valplast specimens absorbed the least water they had the lowest mechanical properties of all materials.

Keywords: PMMA, polyamide, denture base, flexural properties, nano-hardness, water sorption.

Investigating the Role of Self-assembling Peptides for Dental Enamel Regeneration using Multi-modal Synchrotron X-ray Techniques

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Abstract

The structured arrangement of hydroxyapatite crystallites composing enamel gives it remarkable mechanical properties. Nonetheless, enamel remains prone to caries. A minimally-invasive approach to caries treatment involves using the biomimetic peptide P_{11}-4. However, its exact mechanism of action remains unclear. This study aims to employ multi-modal synchrotron X-ray techniques to deepen our understanding of P_{11}-4's role in mineralisation.

Fibrillar P_{11}-4 was applied on silicon nitride windows, which were subsequently immersed in a mineralising solution for various durations. The resulting mineralised P_{11}-4 fibrils were analysed using nano X-ray fluorescence to map elemental distribution and examine mineral morphology.

Artificial caries lesions were induced on enamel sections, followed by immersion in remineralisation solution with or without P_{11}-4 treatment for 120 hours. Subsequently, X-ray diffraction and microtomography mapping techniques were employed. Mineral density post-treatment was determined from tomography image stacks, and crystallite arrangement was evaluated using the spread of the (002) hydroxyapatite diffraction peak. Le Bail refinement was conducted to extract unit-cell lattice parameters across mapped regions.

From the fluorescence data, the presence of P_{11}-4 on the SiN windows was shown to induce and control mineral formation as a function of time. The diffraction data indicates the presence of two distinct populations of HAp crystallites, with population 1 likely corresponding to the prismatic structure and population 2 to the inter-prismatic structure, as indicated by a reduced crystallite arrangement. Remineralisation, with or without P_{11}-4, led to the formation of mineral structures with reduced lattice parameters a- and c- within the demineralised pores (visualised from the tomography data). The presence of P_{11}-4 resulted in smaller pores. The P_{11}-4-treated sample displayed increased crystallite arrangement along the subsurface of enamel, suggesting its involvement in guided remineralisation.

Combining X-ray techniques can assess how soft biomaterials affect the microstructure and nanostructure of mineralised tissues, enabling conclusions about their efficacy in tissue restoration.

134

Unravelling the roles of Runx2 in tooth development and replacement

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Abstract

Mutations in the transcription factor *RUNX*2 lead to Cleidocranial Dysplasia (CD). CD is characterized by supernumerary teeth, enamel hypoplasia, and eruption defects. The mechanisms underlying these dental defects were analysed in a mouse model of CD where *Runx2* was deleted in specific dental populations in the embryo. We found that *Runx2* wasexpressed in both odontogenic epithelium and mesenchyme from early stage of murine tooth development, with the epithelial expression found only on the labial side of the tooth organ. Conditional loss of *Runx2* in the neural crest (Wn*t1creRunx2*) hindered molar development with the lower jaw molar more affected than the upper molar, indicating different regulation of *Runx2* in the upper and lower jaw. Tooth germsregressed at later stages and showed an abnormal pattern of epithelial growth, corresponding to ectopic expression of PCNA. Abnormal nuclear expression of Yap in the epithelium in mutant mice indicated mis-location of the enamel knot, a key structure involved in tooth morphogenesis. The expression of Lef1, which is a readout of Wnt signaling, was not affected in the Runx2mutant mice, indicating *Runx2* does not act upstream of Wnt signaling. Interestingly, the related genes *Runx3* appeared to be able to compensate for loss of *Runx2*, with upregulation of nuclear *Runx3* in the upper dental papilla. In mice with loss of only one copy of *Runx2*, the normally rudimentary successional dental lamina appeared more prominent, potentially linked to the supernumerary teeth observed in patients. *K14creRunx2* mutants, with an epithelial-specific loss of Runx2, did not exhibit an obvious phenotype prenatally, indicating that epithelial *Runx2* expression is not essential for morphogenesis. These findings highlight the importance of transgenic mouse models to study congenital dental disorders and suggest that mesenchymal *Runx2* has an important role in morphogenesis.

135

Can Head and Neck Squamous Cell Carcinoma (HNSCC) cell lines (Fadu) produce soluble factors to convert monocytes/macrophages into the M2 phenotype?

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Abstract

Introduction: In head and neck cancers, high macrophage infiltration is strongly correlated to poor prognosis and tumour progression. Macrophages are categorised into 2 opposing phenotypes: classically activated M1 macrophages which produce proinflammatory cytokines (TNFalpha) and express high levels of the CD86 marker, MHC II; anti-inflammatory M2 subtypes which possess higher phagocytic activity, secrete IL10 and VEGF, and promote tumour progression.

Experiment 1 Aim: To examine the ability of HNSCC cell secreting soluble factor(s) for TNFalpha and IL-10 detection.

Experiment 2 Aim: To examine the ability of HNSCC cell secreting soluble factor(s) for alteration of M1 and M2 cells markers in cultures.

Methods: PMA was used to convert THP-1 monocytes to M0 macrophages. The M1 and M2 macrophages were then polarised with GM-CSF and M-CSF/IL-4 respectively as well as 20% FaDu CM for 24 and 48 hours. In Experiment 1, culture medium was then collected at 24 and 48 hours for TNFalpha and IL-10 ELISA. In Experiment 2, cell lysate was harvested for total RNA extraction for RT-qPCR to test M1 and M2 cell markers expression in mRNA levels.

Results: Fadu-CM strongly stimulates TNF-alpha production, as determined by ELISA at 24 and 48 hours. IL10 production is induced by Fadu-CM after 48 hours to a lesser extent. mRNA levels of CD86 and VEGF were assessed using RT-qPCR and data was normalized for housekeeping gene expression. CD86 was upregulated after 24 hours. Fadu CM strongly stimulates VEGF after 24 hours and downregulates CD86.

Conclusion: M1 and M2 markers can be changed by Fadu-CM. Stimulated levels of both TNF-alpha and IL10 likely promote tumour growth, perhaps due to the controversial dual role of TNF-alpha in inducing and controlling tumours. These preliminary results could inform further investigations into how Fadu-CM can stimulate M2 in cell culture models.

136

Exploring and Optimising the methodology of Mass Spectrometry in Characterising Salivary Proteins

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Abstract

Saliva is a complex dynamic mixture of proteins, minerals and ions which provides a large scope for potential research in its role in biological systems. Previous methods commonly used in salivary research such as mass spectroscopy and gel electrophoresis, were reported to be limited in measuring the complex spectrum of proteins in saliva, due to variability and inefficiency. Mass Photometry (MP) is a novel technique which accurately measures the molecular mass distributions of proteins in solution via light scattering analysis. MP had previously been successfully used to characterise membrane proteins, large protein complexes and binding affinities (Li et al. 2020: Wu and Piszczek 2020). As there is no optimised method of assay for saliva, we aimed to use MP to measure the binding kinetics between protein-protein interactions in saliva. This was achieved by analysing a serial dilution of collected Whole mouth saliva (WMS) and parotid saliva in deionised water, snapshotting every consecutive minute for 10 minutes to gain insight to protein stability and complex formation. Results had shown that WMS analysis was optimised in de-ionised water at 0.005mg/mL concentration (at 25C), detecting stable proteins peaks at: 170kDa (aggregates of amylases, cysteines), 450kDa (secretory IgA), 753 kDa (mucins). Parotid Saliva was optimised at 0.00125mg/mL with stable peaks at 28kDa (basic proline-rich-proteins), 32kDa (acidic proline-rich protein), 60kDa (amylase), however aggregate after 5 minutes. Adding Beta-mercaptoethanol (BME) at 10% we found it caused WMS aggregation at 650kDa, and an increase at 1140kDa with 1% BME within 2 minutes. Suggesting that salivary proteins is a dynamic mixture of proteins which can form complexes. MP has shown to analyse saliva by determining induvial salivary proteins, complex formation and stability with sensitivity, speed, and very low sample sizes. Therefore, MP provides an alternative, modern approach to measuring the protein interactome of saliva.

137

Microtomographic Comparison between SDF and SDF/KI Treatment on Remineralisation and Subsequent Demineralisation of Artificial Enamel Lesions

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Abstract

Introduction: Silver Diammine Fluoride (SDF) is used clinically to treat enamel lesions in primary teeth. KI can be added to reduce the blackening effect. However, KI may alter the chemistry of the process.

Aim and Objectives: To utilize X-ray Microtomography (XMT) imaging to compare changes in mineral density in artificial lesions following remineralisation of enamel treated with SDF with and without KI.

Experimental set-up: Three exfoliated primary teeth were prepared with artificial caries in enamel. Each was painted with nail varnish, leaving a 3x4 mm window and immersed in 50ml demineralisation solution (0.1M acetic acid, pH 4.5) for 72h. All teeth were imaged using XMT at; baseline; after SDF (with and without KI) treatment and immersion in remineralisation solution (0.222 g/L $CaCl_2$, 0.163 g/L KH_2PO_4, 8.7 g/L NaCl) for 120h; followed by subsequent demineralisation for 72h. The changes in linear absorption coefficient (LAC) were imaged at each time point.

Results: For enamel lesions treated with SDF and then remineralised, a radiopaque layer was formed on the surface of the lesion. Also, increases in LAC were seen within the demineralised enamel. There was very little changes in lesion depth following subsequent demineralisation. However, for lesions treated with SDF/KI and then remineralised no radiopaque layer on the lesion surface was seen, but there were increases in LAC within enamel. However, there was very little change in lesion depth following subsequent demineralisation.

Conclusion: The application of SDF onto enamel lesions provides a radiopaque layer (most likely silver) on the lesion surface which will contribute to antimicrobial function. Penetration of silver into enamel seems to reduce further demineralisation. Whereas SDF/KI does not yield a radiopaque layer on the lesion surface but does inhibit further demineralisation. Therefore SDF/KI is likely to be less microbiologically effective for preventive management on enamel lesions.

138

Machinable Barium Fluormica Glass-Ceramics with Curved Crystals For Chairside CAD-CAM Crowns

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Abstract

Introduction - Glass-ceramics based on fluormica are used for industrial machinable glass-ceramics and can be machined and turned like metals and without using diamond tipped tooling. However these glass-ceramics are insufficiently translucent for dental applications.

It has been found by chance that Barium fluormica glass ceramics from the SiO_2-Al_2O_3-B_2O3-BaO-MgO-MgF_2 system with fluorine contents below the stoichiometry of barium fluorphlogopite can crystallise to Barium Fluorphlogopite with an unusual microstructure consisting of curved crystals. Three glass compositions from the SiO_2-Al_2O_3-B_2O_3-BaO-MgO-MgF_2 were synthesised. These t were characterised by XRF, DSC, XRD, solid state ^{19}F MAS-NMR, SEM in the back scattered mode and Vickers hardness.

Results - XRF showed approximately 50% of the fluorine to be lost during melting. All three glasses crystallised to barium fluorphlogopite at temperatures between 850 and 1100°C. The two lowest B_2O_3 glasses exhibited two glass transition temperatures and an optimum nucleation temperature indicative of crystal nucleation involving amorphous phase separation. Examination of the heat treated microstructure shows a microstructure consisting of layers curved crystals in contrast to the normal flat plate like microstructure normally observed termed the "house of cards". In the case of the higher B_2O_3 content glasses the microstructure switched to the house of cards microstructure at higher temperatures. The curved microstructure was associated with an increase in translucency and a much better aesthetic appearance. Switching from the curved crystals to the flat plate like house of cards microstructure was associated with both slight shift in the ^{19}F chemical shift for Barium Fluorphlogopite and a sharpening of the diffraction lines in the XRD patterns suggesting some disorder within the curved crystals. The curved microstructure and the classic house of cards microstructure both resulted in a decrease in hardness and ease of machining.

Conclusions - Glass-ceramics based on curved barium fluorphlogopite are attractive for aesthetic crowns onlays and inlays.

139

Niacin Availability Modulates the Virulence of Pathogens in Biofilm Associated with Noma Disease

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Abstract

Noma is a neglected periodontal disease with up to 90% mortality in children. Malnutrition in Noma patients suggest an inadequate innate immune response. Inflammatory mechanisms that compose innate immunity are strongly influenced by nutrition. We previously highlighted bacteria which are key to the dysbiosis in Noma; *T. Denticola*, *P. Intermedia*, and *F. Nucleatum*. Biofilm formation, invasion of host cells, and evasion/activation of host responses are examples of virulence factors employed by periodontal pathogens. Therefore, Investigating the effect of nutrition on the virulence factors of biofilms related to Noma disease can give more insight on its pathogenesis.

The Biofilms of *T. Denticola*, *P. Intermedia*, and *F. Nucleatum* were studied and confirmed using SEM imaging and 16s rRNA Sequencing. Subsequently, NMR metabolomics was performed on the planktonic coculture and biofilms. The conversion of niacinamide to niacin was identified as a micronutrient metabolism which was unique to the biofilm state of the pathogens. The effects of different niacin concentrations on biofilm formation, invasion of host cells and evasion/activation of host responses were studied using a biomass (crystal violet) assay, lactate dehydrogenase assay, assay of cytokines and RT qPCR of virulent genes.

Niacin did not affect the growth of the planktonic bacterial co-culture but increased the biomass of biofilms. Niacin significantly reduced the invasion of oral epithelial cell by the biofilms within 18 hours. Niacin modulates host cytokines of the innate immune response and genes encoding virulence factors.

Niacin availability modulates biofilm formation, invasion of host cells, and evasion/activation of host responses in biofilm associated with Noma disease. Niacin deficiency is more typically associated with poverty, malnutrition, or malnutrition secondary to chronic alcoholism. It also tends to occur in less developed areas where people eat maize (corn) as a staple food, as maize is the only grain low in digestible niacin.

142

Microtomographic Comparison between SDF and SDF/KI Treatment on Remineralisation and Subsequent Demineralisation of Dentine Lesions

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Abstract

Introduction: Silver Diammine Fluoride (SDF) is used clinically to treat dentine lesions in primary teeth. KI can be added to reduce the blackening effect. However, KI may alter the chemistry of the process.

Aim and Objective: To utilize X-ray Microtomography (XMT) imaging to compare the change in mineral density and the remineralisation effect of SDF with and without KI in dentine caries in primary teeth.

Experimental set-up: Three extracted primary teeth with caries into dentine were selected. All 3 teeth were imaged using XMT at baseline, after SDF (with and without KI) treatment and immersion in remineralisation solution (0.222 g/L CaCl2, 0.163 g/L KH2PO4, 8.7 g/L NaCl) for 120 h, and subsequent demineralisation for 72 h. The changes in linear absorption coefficient (LAC) were imaged at each time point.

Results: For SDF-treated dentine lesions, a radiopaque layer was formed on the surface of the dentine lesion. Islands of high LAC indicated infiltration of silver compound into dentine were also observed within the demineralised lesion. There was no change in LAC at any depth observed after subsequent immersion in demineralisation solution. However, for dentine lesions treated with SDF/KI treatment and immersion in remineralisation solution, there was considerable accumulation of radiopaque material at the surface of the lesion and into the body of the lesion. No further decrease in LAC was observed after subsequent immersion of the tooth sample in the demineralisation solution.

Conclusion: SDF treatment of dentinal lesions results in the formation of a sacrificial barrier of a silver salt. The addition of KI significantly improves the transport of silver into dentine, thereby improving its clinical efficacy.

143

Assessing Optimised Centrifugation Conditions for Quantitative Proton Nuclear Magnetic Resonance (1H NMR) Spectroscopy of Saliva with Sweeteners

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Abstract

Objective: Centrifugation is critical for eliminating residual cells that can overlap spectral peaks, yet this may result in alteration metabolite profile of saliva. The aim of this study was to optimise centrifugation parameters in the preparation of saliva samples containing sweeteners, for ^{1}HNMR spectroscopy. **Method:** Approximately 6 mL of saliva was collected from 4 healthy university students. Each sample was mixed with designated concentrations of sucrose, aspartame, Ace-K, and saccharin to mirror average daily intake, and gently agitated to ensure uniformity. Nine aliquots were prepared from each sample; one from each volunteer was left uncentrifuged as a control to study the effects of centrifugation. The remaining aliquots were centrifuged at 350g, 750g, and 1500g for durations of 2, 4, and 6 minutes at 4°C. All samples were kept on ice throughout the preparation process and stored at −20 °C prior to analysis. Spectroscopic measurements were conducted using a Bruker Avance III spectrometer at 700MHz.**Results:** Non-centrifuged saliva samples showed broad resonance (~1.24- 3.0 ppm), with overlapping of the lactate doublet at ~1.32 ppm. The repeated NMR measures indicated significant differences in both sweetener and lactate concentrations between centrifuged, and non-centrifuged samples (p<0.05). Bonferroni tests of the data showed that centrifugation at 750g for 4 minutes optimally removed debris. Centrifugation at 750g for 4 minutes minimised interference while maintaining consistent profiles for all sweeteners. Excessive centrifugation (1500g) and prolonged centrifugation times (6 minutes) distorted peaks, particularly for aspartame and Ace-K. In all cases 6-minute centrifugation showed increased suppression of peaks, suggesting excessive cell disruption and potential metabolite loss. **Conclusion:** The centrifugation at 750g for 4 minutes proved optimal for NMR analysis, effectively removing interfering debris while maintaining a consistent metabolite profile for accurate quantification of sucrose, aspartame, Ace-K, and saccharin.

144

Depth of Cure: Different Types of Composite Resin Restorative Materials

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Abstract

The depth of cure is one of the important factor for the longevity of the direct composite restorations. The aim of the present study was to evaluate the depth of cure of different types (conventional, bulk-fill and short-fiber reinforced) of light cured direct composite resin restorative materials measured with instrumented indentation technique (IIT).

Two types of short-fibre reinforced flowable composite resin, bulk- and dentin-shade (everXFlow/GC), bulk-fill flowable (Dental; SDR flow+/Dentsply Sirona) and four conventional (Filtek Universal Restorative/3M-ESPE; TetricPrime/Ivoclar-Vivadent; Omnichroma One Shade/Tokuyama; Venus Diamond/Kulzer) light cured composite resin restorative materials were tested.

Specimens were prepared using a black mold (16mm height 4.5mm diameter). Test materials were inserted into the mold and light irradiated using a LED curing unit (EliparS-10-3M/ESPE) with two different 20s or 40s exposure time. Cylindrical specimens were grinded at middle surface of cylinder with 1000-, 4000-grit SiC for 30s, consecutively to obtain rectangular test specimens.

Test specimens were placed in indentation tester (Surface Materials Tester, SMT-5000, Rtec Instruments) and surface hardness (HIT) was measured by applying 5N force for 3s. Three parallel measurements were obtained, starting from 0.1mm distance from light irradiated edge and continued every 0.5mm longitudinal distance. Surface hardness was used as indicative unit for curing and HIT values <20% less than the value of the first reading were considered to demonstrate adequate cure. Data was statistically evaluated by two-way ANOVA .

Bulk-shade short-fibre reinforced composite revealed highest depth of cure for both 20sec and 40sec light irradiation time at 6mm and 8mm respectively (ANOVA, $p<0.001$). Curing time has significant effect (ANOVA, $p<0.001$) on depth of cure of all tested materials.

For all tested light cured composite resin restorative materials, 40s light irradiation time, increased the depth of cure values. Considering depth of cure, clinically relevant light irradiation time should be 40s.

145

3D-Finite Element Crown-Implant-Bone Model: Design and Validation

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Abstract

Objectives: The aim was to design and validate a 3D-finite element model for crown-implant-bone research.

Methods: A 3D model of a mandibular posterior crown-implant-bone was designed using Solid Works 2022 SP3.1 (*Dassault Systems*) and Abaqus 2022 (*Simulia*). Eight geometric parts were generated: cancellous and trabecular bones, gingiva, implant fixture, mini-screw, abutment, cement, and crown. All parts were divided in volumetric finite elements with a linear tetrahedral shape (C3D4). Interactions among the model parts were considered "tie" to represent 100% of osteointegration with a coefficient of friction of 0.3. To validate the model, a distributed load of 100N was applied to the crown. The bone was fully constrained (X, Y, and Z directions) and a load was applied to the crown. For a linear analysis, the materials were considered linear, elastic, isotropic, and homogeneous, so elastic modulus and the Poisson's ratio were the input parameters. The stress distribution was verified by colour fringe graphic representation of the stresses generated in the model.

Results: The stress-patterns generated in the crown-implant-bone model were truly 3D. Stress concentrations were found at the surface where the load was applied and in the vicinity of the abutment-implant interface due to its complex geometry.

Conclusion: The 3D crown-implant-bone model has potential for future simulations such as bone density research, and the effect of the bone remodelling dependent upon different loading applications. Moreover, this model can be used for the development of further implant systems, considering different geometries, material properties, and boundary conditions.

146

Validating Pectin Hydrogel's Biocompatibility with SHED Stem Cells for Future Regenerative Endodontic Applications

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Abstract

Background: Regenerative endodontic therapy (RET) is used to treat non-vital immature teeth. Despite its advancement, challenges remain in eliminating bacterial biofilms while maintaining a cell-friendly environment. Natural materials offer alternatives to overcome limitations of synthetic materials. Our group confirmed pectin's antimicrobial effect against single species, and we are studying its biocompatibility with stem cells from deciduous teeth (SHEDs) due to their high regeneration potential and possibility of successful banking, making them excellent candidates for RET.

Aim: To confirm the biocompatibility of Pectin to SHED stem cells invitro with a view of clinical translation in regenerative endodontics.

Materials and methods: SHEDs were obtained from deciduous teeth via dental tissue bank, Leeds School of Dentistry and seeded in triplicates in 12 well plates coated with 2% Pectin hydrogel (Classic, Herbstreith and Fox, Germany). Cell viability (live/dead staining), proliferation (WST-1), and material cytotoxicity (LDH assays) were assessed at 24 hours, 3 days, and 7 days.

Results: After 24 hours, 3 days, and 7 days, SHEDs maintained viability and showed comparable cell attachment to control cells cultured in uncoated plates. The proliferation rate was slightly higher in Pectin group (50% at 24h ,300% at 3d,450% at 7 days) compared to uncoated control group which showed 100% proliferation at all time points. The cell death rate was higher in the Pectin group after 24 h (29%) and 3 days (38%) compared to the uncoated control group (12%at 24h,17% at 3 days). However, both pectin and controls showed significantly lower cell death rate in comparison to positive control (100% death rate). Furthermore after 7 days, Pectin coated groups showed similar cell death rate compared to uncoated controls.

Conclusion: This study confirmed biocompatibility of Pectin with SHEDs, further investigation on the bioactivity of pectin (mineralisation and gene expression assays) will be carried out in the future.

147

Multilayer 2D-Axisymmetric Finite Element Analysis of a Tooth-Ceramic Model under Biaxial Flexural Loading

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Abstract

Objectives: The aim was to verify the stress distribution on a Multilayer 2D-Axisymmetric finite element model of tooth-ceramic under biaxial flexural loading.

Methods: A multilayer 2D-Axisymmetric model of tooth-ceramic was designed using Abaqus 2022 (*Simulia*). One model was generated containing five geometric parts: indentor, ceramic, resin-cement, dentine, and ring. A second model was generated including 'enamel' as a part. All parts were divided in volumetric finite elements with a linear quadrilateral shape (CAX4). Interactions among the model parts were considered "tie" to avoid the penetration between each layer. A coefficient of friction of 0.73 between the indentor and the ceramic was assumed. To validate the model, a parafunctional load of 800 N was considered. The ring was constrained in all directions (X, Y, and Z) and the models were constrained on their axisymmetric planes. For a linear analysis, the materials were considered linear, elastic, isotropic, and homogeneous, so elastic modulus and the Poisson's ratio were the input parameters. The maximum principal stress distribution was verified by colour fringe graphic representation of the stresses generated in the model.

Results: The stress-patterns generated in both models (4 and 3-layers) were promising regarding the use of ultrathin ceramics. Stress concentrations were found close to the indentor load contact, and at the bottom of the ceramic layer, showing the tensile stress concentration generated by the biaxial flexural load.

Conclusion: The 2D-Axisymmetric finite element model is representative of the stresses generated at ultrathin ceramics with and without the presence of enamel. This model can be used for the development of further ceramic layer treatments.

148

Feasibility study exploring the metagenomics of the oral microbiome and its associations with head and neck cancer stage and site

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Abstract

Introduction/Background:

Initial research has explored associations between the oral microbiome and HNC utilising 16sRNA technologies. Metagenomic analysis enables the function and structure of the entire microbiome to be explored potentially uncovering uncultivable species and quantitatively analysing results. This study explores the feasibility of undertaking high level microbiological analysis to understand the associations between the oral microbiome and HNC.

Methods:

Translational Studies of Head and Neck Cancer in South America (HEADSpAcE) is a multi-centre study co-ordinated by the International Agency for Research on Cancer (IARC). Work-package 2 seeks to understand the socioeconomic, logistical, and biological predictors of delayed head and neck cancer (HNC) diagnosis in Europe and South America.

This project is nested within an observational cohort study utilising a mixed-methods methodology targeting the recruitment of 100 individuals with a new diagnosis of HNC in the West of Scotland.

Standard operating procedures (SOPs) were developed for the collection and processing of biological samples including blood, oral rinse, and saliva complimenting a brief lifestyle interview containing recording sociodemographic, behavioural, and route to diagnosis data exploring delay between symptoms and diagnosis.

Results:

SOPs were generated, and training delivered to research teams, to facilitate the clinical collection, processing, and storage of biological samples across four centres in Glasgow.

Of the 100 individuals recruited, oral rinse samples were collected from 86 individuals. Following DNA extraction, 83 samples were available for shotgun sequencing and metagenomic analysis.

A bioinformatic pipeline has been developed to explore alpha and beta diversities in addition to exploring associations between stage and site and other epidemiological data obtained.

Conclusions:

Recruitment and collection of biological samples from individuals with HNC to enable metagenomic analysis is feasible. Further downstream bioinformatic results remain pending.

Disclosures:

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149

Therapeutic Potential of Targeted Inhibitors and Clobetasol in a Novel T-Cell-Mediated Oral Mucosal Disease Model

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Abstract

Introduction: T-cell-mediated oral mucocutaneous inflammatory conditions, including oral lichen planus (OLP), are prevalent, but new treatments to alleviate symptoms and control OLP progression are hampered by the lack of experimental models.

Materials and Methods: An in vitro model of T-cell-mediated inflammatory oral mucosal disease was constructed by placing an oral mucosal equivalent (OME) on top of a hydrogel containing Th1 and cytotoxic CD8+ T-cells. The model was stimulated with IFN-γ and TNF-α to induce cytokine and chemokine production and analyzed over a 15-day period. The levels of CXCL9, CXCL10, and CCL5 were quantified in the conditioned media. Treatment strategies included the use of JAK inhibitors (ruxolitinib, decernotinib, roflumilast), NS6180 (a K Ca 3.1 channel inhibitor), clobetasol-17-propionate, and a mucoadhesive patch containing clobetasol-17-propionate.

Results: The model developed features of T-cell-mediated inflammatory oral mucosal disease, including T-cell recruitment to the epithelium, elevated levels of chemoattractants CCL5, CXCL9, and CXCL10, and histological evidence of basement membrane destruction and tissue damage associated with cleaved caspase-3 and altered laminin-5 expression. Treatment with JAK inhibitors, K Ca 3.1 channel inhibitors, clobetasol in solution, or clobetasol via a mucoadhesive patch effectively prevented cytokine and chemokine release and reduced tissue damage. Treatment with clobetasol significantly decreased the secretion of key T-cell chemokines, including CCL5 ($p < 0.05$), CXCL9 ($p < 0.001$), and CXCL10 ($p < 0.05$). Both solution and patch forms of clobetasol treatment maintained an intact epithelium with minimal signs of damage.

Conclusion: Treatment with JAK inhibitors, K Ca 3.1 channel inhibitors, and clobetasol in solution and/or via a mucoadhesive patch effectively prevented cytokine and chemokine release and mitigated tissue damage in the T-cell-mediated inflammatory oral mucosal disease model. This novel disease model holds significant potential for probing mechanisms of pathogenesis and serves as a test platform for novel therapeutics and treatment modalities.

150

Investigating the Impact of Layered Double Hydroxide Addition on the Degree of Conversion of Adhesive Resin

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Abstract

Background: It has been well documented that maintaining a therapeutic low-level release of fluoride in the oral cavity is necessary to prevent early-stage carious lesions. Thus, the creation of a substance with the ability to release fluoride at a therapeutic level is necessary. The exchange and release of fluoride anion is possible with Layered Double Hydroxide (LDH). It has the potential for controlled fluoride release in dental applications, such as adhesive strips, varnishes, and fissure sealants. This study focuses on investigating the impact of incorporating ZnAl-LDH, as a valuable nanofiller, into adhesive resin formulations on the degree of conversion, which is a crucial parameter affecting the final mechanical performance of the adhesive resin.

Methods: 2:1 ZnAl LDH was synthesised using a co-precipitation method. Light-curable experimental adhesive resin samples were prepared with varying concentrations of ZnAl-LDH (0, 10 and 30% wt%), while also varying the amounts of 4-meta (0, 2 and 10 wt%). Fourier-transform infrared spectroscopy (FTIR) was employed to assess the degree of conversion by analysing the peaks corresponding to the functional groups of the resin.

Results: The degree of conversion varied from 83.12±1.6 to 88.46±1.1, and was influenced by the amount of 4-meta and LDH present in the polymeric matrixes. The degree of conversion decreased with the addition of ZnAl-LDH ($p=0.008$) and increased with a higher amount of 4-meta ($p=0.009$) indicating improved polymerisation and cross-linking.

Conclusion: The incorporation of ZnAl-LDH into adhesive resin formulations significantly influenced the degree of conversion. However, all samples showed a high degree of conversion. Further investigations, including mechanical testing and long-term stability evaluations, are recommended to comprehensively assess the overall performance of the modified adhesive resin.

151

The Tribology of Tooth Brushing Using Spherical Silica

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Abstract

Background

Toothbrushing is the primary method of preventing caries and maintaining good oral health. The brushing relies primarily on abrasive particles to provide the cleaning; however, the angular silica abrasive has the potential to damage the enamel surface particularly when in partnership with enamel erosion. Spherical silica has been shown to have lower Relative Enamel Abrasivity values, yet a greater cleaning efficiency, even at lower abrasive loadings, but the tribology behind this performance is poorly understood.

Methods

Multipass ramped load nanoscratch tests were performed on human enamel samples using either a 2 µm or 5 µm spherical tip with load ranges of 0-50 mN and 0-200 mN respectively, to provide a range of overlapping contact pressure conditions. All testing was performed with the sample fully hydrated and submerged in Phosphate buffered saline. Scanning electron microscopy was used to characterise and identify the onset point of deformation, which was then related to the contact conditions at that point in the scratch.

Results

Results demonstrate the contact conditions (normal load, hertzian contact pressures and shear stresses) required for the onset of permanent damage using spherical abrasive particles, as the load progressed the observed mechanism of damage evolved from plastic deformation through to cutting of the enamel prisms and then into brittle fracture.

Conclusions

Smaller particle sizes have the potential to initiate damage to enamel surfaces at lower normal applied loads due to the increased shear stresses generated at the contact interface.

152

The impacts of private dental practice entry on access to NHS dentistry in England.

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Abstract

Aim

To investigate the impact of establishing a private dental practice on access to NHS dentistry

Introduction

Dentistry in the United Kingdom is provided in a mixed market; there is both private and public funding as well as private and public provision of services (Daly et. al. 2013). Access to NHS dentistry has struggled to recover following the COVID-19 pandemic, with evidence of a rising proportion of patients choosing to go private due to shortages (NHS England 2023). The impact of an increase in supply of private providers on public healthcare delivery has been explored mainly in hospital settings, finding that an influx of private providers decreased waiting times for elective surgery but slightly reduced quality (Kelly et. al. 2020). However, this has not been explored in dentistry or primary care more widely.

Methods

We use data on quarterly practice registration in England from the CQC from 2015 to 2022 and combine this with publicly available contract and activity data from NHS England to develop a dataset of geolocated private and NHS practices. NHS practices within a 30km radius of the private practice are considered to experience the treatment, and we create a matched set of control practices, matching on contract size in the pre-treatment period, private practices in the surrounding area, land local area age, ethnicity and deprivation profiles. We conduct a staggered difference-in-differences analysis (Callaway & Sant'Anna 2021), where our main outcome variable is the proportion of courses of treatment that are exempt in each practice. We also analyse the total delivered activity levels, practice clawback at the intensive and extensive margin and number of clinicians delivering NHS care.

Results for this paper will be presented during the poster presentation. The results of this study can help to inform strategies to improve access to NHS dentistry.

153

Reinforcement of Light-Curable Dental Resin Composites by Hexagonal Boron Nitride: Effects on Mechanical Properties and Curability

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Abstract

Objectives:

The aim of this study was to investigate the reinforcement of hexagonal boron nitride (hBN) in light-curable dental resin composite formulations and its effect on light curability.

Methods:

Experimental resin composites were formulated with various hBN powders at different filler loadings. The microstructure of filler particles and the morphology of fractured and cross-sectional surfaces of resin composites were examined using a scanning electron microscope (SEM). The aspect ratio profiles of hBN powders were calculated based on atom force microscope (AFM) measurements. Light transmittance, degree of conversion (DC), Vickers microhardness, flexural strength and flexural modulus were assessed to explore the curability and reinforcing mechanism of hBN.

Results:

Various hBN powders exhibited different morphologies, sizes and aspect ratios. Increasing hBN filler loading into the resin composites led to a reduction in maximum irradiance (I_{max}), light transmittance (%), and prolonged curing time to reach I_{max}. The 24h post-curing DC of all hBN groups significantly decreased compared to the no hBN control, yet remained within an acceptable range for clinical application (≈70%). Groups with a small amount of hBN exhibited significant improvement in top surface microhardness, flexural strength and modulus compared to the reference, while high filler loading resulted in a decreasing trend in these properties. SEM analysis identified fractured hBN sheets on fractured surfaces of all groups. Local agglomerations of hBN on both fractured and cross-sectional surfaces were observed in all higher filler loading groups.

Significance:

The incorporation of hBN can enhance the mechanical properties of dental resin composites without compromising curability. However, further investigation is required to explore higher hBN loading and ensure better dispersion of hBN in the dental resin composites.

154

The impact of bariatric surgery versus non-surgical intervention on oral health-A systematic review

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Abstract

Background: Obesity is considered one of the chronic diseases around the world in 21st century. The use of bariatric surgery for treatment of obesity has increased recently. Evidence has shown limited long-term effectiveness of surgery complication after period of time on overall oral health. There is limited evidence on the impact of oral health following the bariatric surgery.

Objective: This systematic review aimed to identify and review the impact of bariatric surgery on oral health status in obese patients (BMI ≥ 35) before and after surgery.

Methods: An electronic comprehensive literature search was conducted in PubMed/MEDLINE, Embase, Scopus, ClinicalTrials.gov, SciELO, Lilacs and Cochrane Central Register of Controlled Trials (until April 2024). Google and Open Grey were used to search for grey literature and handsearching was conducted. The studies obtained from the searches in electronic databases were reviewed individually and independently by two reviewers and the relevant titles and abstracts were selected with specific inclusion and exclusion criteria. Articles published in languages other than English were also included following translation. Cochrane risk of bias tool was decided for quality assessment of clinical randomised studies, whilst ROBINS-I tool was chosen for non-randomised studies.

Results: The initial search carried out for publications up to April 2024. The electronic database generated 2458 results. In total, 2185 studies were found to be relevant from which 273 duplicates were removed. Subsequently, all aforementioned studies were imported on Covidence software for screening. Title and abstract screening were then conducted, and a total of 290 studies found to meet the inclusion criteria were assessed for full text screening. Further Interpretation of the study's finding and implications are being assessed.

Conclusion: This systematic review is limited further data extraction and analyses are being carried out.

The systematic review registered in PROSPERO, International prospective register of systematic reviews, No CRD42023485829.

155

Salivary ferns; a potential mechanism

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Abstract

When a drop of saliva is dried on glass it forms characteristic fern-like patterns. Electron microscopy reveals these are composed of cubed crystals stacked on top of each other. Energy dispersive X-Ray spectroscopy indicates the crystals are potassium chloride although other analyses suggested sodium chloride. Raman spectroscopy indicated two peaks (1002 and 1053) corresponding to peptide and carbonate with greater amounts of peptide on the ferns and greater carbonate between ferns. To further investigate the role of protein in the ferning process a fluorescently labelled protein was added to saliva and the drops of saliva allowed to dry. Fluorescent protein localised to the outer surface of the ferns with greatest staining at the centre of the drop. In contrast, fluorescent dye not linked to protein localised to the outer edge of the drop (reminiscent of the coffee-ring effect). To further investigate the salivary ferning process it was replicated using a mixture of ions (NaCl, KCl, MgCL2 and CaCl2) and a model protein (bovine serum albumin). Omitting the monovalent ions altered the ferning pattern, whilst omitting the divalent disrupted the formation of ferns from the starting crystal. Omitting protein prevented ferns forming at all, only individual large crystals formed. Lastly the addition of bicarbonate inhibited finer fern formation. A possible mechanism will be presented which explains these results and its application to salivary protein binding to teeth will be discussed.

156

Literature search and analysis through the lens of AI - exploring dental student views of ResearchRabbit

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Abstract

Introduction A core component of evidence-based dentistry is to conduct literature search and analysis, a process that can now be supported by AI-technologies. In this project ResearchRabbit (RR), an AI tool, was introduced to first-year dental students. RR is a free AI tool that helps users find bibliographies based on seed articles, create connective maps for literature analysis, and manage bibliography collections. The aim of the study was to assess the potential of RR to enhance literature search and analysis and to look at student's acceptance and adoption of RR.

Materials and methods In this study we conducted a content and thematic analysis of student narrated group presentations (n=21), which utilised RR, using the United Theory of Acceptance and Use of Technology (UTAUT) model.

Results Data collected revealed diverse perspectives on the platform's effectiveness. The dominant constructs from the UTAUT framework were performance expectancy and effort expectancy. The groups frequently noted that RR streamlined literature searching, appreciating its ability to save time and effort. They valued the platform's usefulness for task accomplishment, highlighting features such as adding articles to collections and creating connective maps for analysis. However, several groups reported the opposite experience, stating that RR did not save time nor were the features beneficial. Additionally, while some students appreciated the platform's efficiency, others encountered challenges with the user interface and ease of navigation.

Discussions and conclusion Students' divergent views on the perceived usefulness of the RR platform indicate a need for further exploration to understand the factors behind these opposite perspectives. A standardized comparison with similar tools would be beneficial for evaluating RR's usefulness. This research design provides a template for trialling other AI tools in an educational setting and also scope to study how dental students develop their AI literacy after exposure to AI-based tools in their first year.

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Alabbad	Mohammed	18
Alaqil	Faten	150
Alasaadi	Saeed	145
Alhazmi	Muntha I	76
Alhedyan	Faisal S	113
Alli	Lara	128
Allison	James	31
Almutairi	Abdulrahman	38
Al-Namnam	Nisreen	19
Alolayani	Bader	106
Alqahtani	Abdullah	88
Alqhtani	Nasser	92
Alrashed	Muath	86
Alshammari	Adel	100
Anderson	Paul	137
Asfari ايلاف أصفري	Elaf	24
Ashcroft	Lauren	33
Baysan	Aylin	154
Beacher	Nick	148
Belhoul AlFalasi	Khawla	10
Belhoul AlFalasi	Khawla	11
Bissett	Susan	47
Borba	Marcia	108
Boyers	Dwayne	119
Brown	Jason	59
Buolikeze	Kuoh	30
Campbell	Faith	62
Carpenter	Guy	155

Carr	Katherine	29
Cassie	Heather	61
Charoenwongwatthana	Pisit	114
Choi	Jiwon	105
Chotaliya	Sneha	80
Coughlan	James	152
Cresswell-Boyes	Alexander	74
Desor	Kishan	156
Dias	Isabel	121
Doble	Amazon	85
Dyke	Thomas	151
El Howati	Asma	149
Elsadek	Yasmen	98
Elsadek	Yasmen	111
Fan	Jiaqian	153
Farmer	Sarah	20
Febriansyah	Rifaldo	147
Gao	Yan	117
Gibson	Barry	75
Goktug	Irmak	21
Gomez	Paola	112
Gonnah	Reham	133
Hajali	Zaineh	122
Hamid	Aruche	83
Hasan	Mahmoud	37
Heggie	Claudia	48
Hill	Robert	138
Holliday	Richard	82
Huang	Shasha	109
Hussein	Nesma	115
Jablonski	Rachael	68
John	Nathan	87
Kaur	Mandeep	142
Keshavarz	Samaneh	41
Keyhanian	Yasmin	135
Koshy	Dhanya	116
Kronic	Jelena	8
Latif	Arsalan	102
Li	Xiang	17

Liu	Lu	16
Lopez oliva	Isabel	14
Lu	Xuanyun	34
Luo	Wen	28
Makanjuola	John	35
Mather	Helen	71
McGrogan	Claire	45
McGrogan	Claire	54
Mehta	Neha	81
Mongkolngamcharoen	Thanaporn	43
Morgan	Sian	51
Mukhtar	Amir	12
Mullan	Francesca	60
Murchie	Bryan	27
Mya	Victoria	67
Najmi	Yasna	64
Nasution	Hubban	132
Negm	Enas Elhamy Elsayed	66
Nikooseresht	Parisa	143
Ooi	Lynn	49
Pavitt	Sue	57
Penlington	Chris	23
Rahimi	Hameed	44
Ramalingam	Chandra	73
Raman	Veksina	129
Randall-Morgan	Levi	99
Rowan	Laurence	58
Roye	Ashley	79
Salama	Heba	95
Salami	Anas	9
Shahid	Saroash	56
Slowik	Klaudia	50
Songwatcharaporn	Artit	118
Stafford	Graham P	22
Sukumaran	Prema	25
T	Ticha	40
Tahsin	Nishat	136
Takarini	Veni	69
Taylor	Greig	124

Terry	Samie-Jo	65
Timms	Laura	42
Trus	Pavlos	26
Uctasli	Sadullah	144
Uzochukwu	Joshua	139
Warner	Frances	96
Whawell	Simon	77
Whawell	Simon	78
Wiench	Malgorzata	103
Wu	Rui	55
Yan	Fan	120
Yanez	Carolina	72
Yang	Litian	53
Yang	Litian	134
Yevlashevskaya	Olga	101
Yuan	Shuai	107
Zhang	Yuchen	52
Zhang	Tianyu	84