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ABSTRACT BOOK

Oral Presentations

"Magnesium Chloride vs. Magnesium Oxide: A Comparative Study of Their Dentinogenic Effects on Human Dental Pulp Cells"

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Abstract

BACKGROUND: Magnesium-based biomaterials might provide an innovative therapeutic potential to substantially enhance regeneration of dental tissues. Although Magnesium (Mg^{2+}) enhances osteoblastic activity, the dentinogenic effects of magnesium chloride ($MgCl_2$) and magnesium oxide (MgO) on human dental pulp cells (HDPCs) remain unclear.

PURPOSE: To compare the stimulatory effect of $MgCl_2$ and MgO on dentinogenesis of HDPCs and associated signaling pathways. **METHODS:** HDPCs were cultured with 0.5mM, 1mM, 2mM, 4mM, 8mM concentrations of supplemental $MgCl_2$ and MgO , 0 mM as negative control. Crystal violet staining to determine cell attachment and proliferation rate. Cell viability investigated by MTT assay. Odontogenic differentiation assessed by evaluating alkaline phosphatase (ALP) activity, expression of dentin sialoprotein (DSP), dentin matrix protein 1 (DMP-1), dentin sialophosphoprotein (DSPP), type I collagen (COL-I), and mineralization. Expression of bone morphogenic protein (BMP-2), phosphorylated SMADs 1/5/9, p-p38, p38, p-JNK, JNK, p-ERK1/2, ERK1/2 mitogen-activated protein kinase (MAPK) were investigated. Statistical analysis using ANOVA. **RESULTS:** 0.5 mM-2mM $MgCl_2$ elicited the highest stimulatory effect on attachment, proliferation rate, ALP activity, expression of dentinogenic proteins (DSP, DMP-1, DSPP, COL-I), expression of cellular signaling proteins (BMP-2, phosphorylated SMADs 1/5/9, p-p38, p-JNK) mineralization, and down regulation of p-ERK 1/2 compared to control ($P < 0.0001$). 0.5 mM MgO showed higher attachment, proliferation, cell viability, ALP activity, expression of dentinogenic proteins (DSP, DMP-1, DSPP, COL-I), cellular signaling proteins (BMP-2, phosphorylated SMADs 1/5/9), and mineralization than control ($P < 0.001$). **CONCLUSION:** $MgCl_2$ yielded a wider range of effective concentrations upregulating the dentinogenic effect of HDPCs. $MgCl_2$ could be a promising novel material for dentin repair in regenerative endodontics.

Effect of orange cystatin against dentin erosion in vitro

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Abstract

This study evaluated the protective effect of a novel orange-derived protein (CsinCPI-2) and identified the most effective concentration for preventing dentin erosion in vitro. A total of 105 bovine dentin samples (4 × 4 mm) were divided into seven groups: deionized water (control), Elmex™ commercial solution, 0.1 mg/mL CaneCPI-5, and CsinCPI-2 at concentrations of 0.01, 0.1, 0.25, and 0.5 mg/mL. Samples were treated with the respective solutions (250 µL, 1 h, 37°C), followed by acquired pellicle formation using unstimulated human saliva (2 h). An erosive challenge was then performed with 0.65% citric acid (pH 3.4, 1 min). This cycle was repeated once daily for three days. Surface microhardness change (%SMC) and relative surface reflection intensity (%SRI) were analyzed. Statistical analysis was performed using ANOVA/Tukey and Kruskal–Wallis/Dunn tests ($p < 0.05$). For %SMC, CaneCPI-5 and CsinCPI-2 at 0.01, 0.1, and 0.25 mg/mL significantly reduced mineral loss compared with the water control ($p < 0.01$). The water group did not differ from Elmex™ or CsinCPI-2 at 0.5 mg/mL. Notably, CsinCPI-2 at 0.01 mg/mL showed superior protection compared with Elmex™ and the highest CsinCPI-2 concentration. Regarding %SRI, CaneCPI-5 and CsinCPI-2 at 0.01 and 0.1 mg/mL showed significantly higher values than the water and Elmex™ groups ($p < 0.05$), while higher concentrations showed intermediate effects. In conclusion, CsinCPI-2 at 0.01 and 0.1 mg/mL demonstrated the greatest protective effect against dentin erosion in vitro.

Genomic analysis of strain level variation in virulent potential of oral *Fusobacterium nucleatum*: associations with periodontal disease and implications for colorectal cancer risk

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Abstract

Introduction: *Fusobacterium nucleatum* (*F. nucleatum*) has a clear role in periodontal disease and is increasingly implicated in colorectal cancer (CRC). Its genetic heterogeneity and existence in a complex polymicrobial biofilm limits interpretation of conventional microbiome analyses. This research aims to resolve strain-level variation in *F. nucleatum* and determine associations between variation in virulence gene carriage, periodontal health and CRC risk.

Methods: Whole genomes of 20 cultured isolates were assembled using long-read sequencing. Manual curation of biologically relevant genes, including the CRC associated *fad* gene family was performed, informing the design of qPCR primers. These were used on whole plaque and saliva sample DNA from individuals with periodontal health, gingivitis and periodontitis.

Results: Whole genome analysis demonstrated substantial strain level diversity and revealed subspecies and strain-specific gene profiles. Comparative genomics and phylogeny revealed distinct subspecies clustering and extensive genomic rearrangement, as well as clear patterns in gene prevalence and sequence variation. qPCR analysis of whole samples identified elevated relative *fadB* gene copy number in samples from patients with periodontitis and gingivitis, compared to healthy controls. Comparison of *F. nucleatum* populations derived from culturing to whole sample qPCR revealed significant culture bias.

Discussion: The findings demonstrate that periodontitis is associated with enrichment of *F. nucleatum* strains carrying the CRC relevant virulence determinant *fadB* which has been demonstrated to upregulate the expression of β -catenin, a key gene involved in cancer initiation and progression. The methodology developed establishes a scalable framework for resolving biologically meaningful strain-level variation in a complex organism within the oral microbiome. This approach provides new mechanistic insight into how periodontal disease may contribute to systemic cancer risk through differential carriage of virulence genes, that would not be revealed by standard metagenomic or culture-based approaches alone.

Neuroimmune Regulation of Dental Pulp Stem Cell Fate During Infection and Repair

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Abstract

Dental pulp stem cells (DPSCs) are mesenchymal stem cells within the dental pulp that contribute to dentine formation and tissue repair. Beyond their regenerative capacity, DPSCs exhibit neural-like characteristics and intrinsic immunomodulatory functions. However, the mechanisms through which neural signalling and inflammatory stimuli interact to regulate DPSC behaviour during pulpal infection remain poorly understood.

To investigate how DPSCs regulate their fate within an inflammatory microenvironment, we examined signalling pathways governing proliferative state and adaptive cellular responses. Basal cholinergic profiling revealed that DPSCs express functional muscarinic acetylcholine receptors, including the type 2 muscarinic receptor (m2AChR). Pharmacological activation of m2AChR produced a reversible reduction in proliferation associated with G2/M cell-cycle arrest and increased expression of quiescence-related markers, without compromising cell viability or stemness. This state was also characterised by impaired migration and reduced osteogenic differentiation and was associated with modulation of MAPK/ERK signalling, consistent with induction of a regulated quiescent-like phenotype.

To model inflammatory conditions relevant to deep caries and pulpal exposure, DPSCs were exposed to soluble factors derived from a four-species interkingdom endodontic biofilm. Biofilm supernatant reduced DPSC metabolic activity without inducing apoptosis or necrosis and triggered a pronounced time-dependent transcriptional response. Early responses were dominated by inflammatory mediators with enrichment of TNF, NF- κ B, and JAK–STAT signalling pathways, while later responses reflected redox regulation, metabolic suppression, and tissue-adaptive transcriptional programs.

Together, these findings indicate that DPSCs integrate neural and biofilm-derived inflammatory signals to regulate proliferative restraint and adaptive immunometabolic responses during pulpal infection and repair.

Evaluating Multimedia MCQs in a Dental Formative Assessment

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Abstract

Multiple Choice Questions (MCQs) remain widely used in higher education due to their scalability and efficiency. However, concerns about their capacity to assess deeper learning have intensified with the emergence of AI tools capable of solving text-based MCQs with minimal cognitive effort. Multimedia MCQs (M-MCQs), which integrate nontextual elements such as images and videos, offer a potential means to promote visual reasoning and reduce linguistic load, though evidence within dental education remains limited.

This mixed-methods study examined the use of M-MCQs within a biomedicine formative assessment for a Year1 dental cohort. A total of 133 students completed an assessment containing both multimedia and traditional MCQs, generating learning-analytics data on performance and engagement. Post-assessment questionnaires (n=71) explored usability and perceived authenticity.

Students reported generally positive experiences with M-MCQs. Histology items that enabled zooming into tissue sections were considered particularly helpful for contextualising structures. Feedback on multimedia anatomy questions was more varied; some students valued the visual approach, others found the question focus unclear, highlighting the need for more explicit prompts and cues.

Learning-analytics data indicated a performance gap between higher and lower-performing students on M-MCQs (75.4% vs 38.3%). Although viewing time did not differ significantly between groups, higher-performing students revisited questions more frequently, suggesting deeper engagement. Lower-performing students tended not to revisit items, potentially reflecting time pressure or disengagement.

Overall, findings suggest that M-MCQ performance is influenced more by engagement quality than time spent. M-MCQs can support visual reasoning and deeper cognitive processing, but their effectiveness relies on purposeful multimedia design.

Understanding oral hygiene in independent living older adults: An ergonomic and ethnographic study

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Abstract

Oral hygiene is a fundamental daily practice for maintaining oral health, yet it is typically studied through isolated outcomes such as plaque scores or self-reported behaviour. This study adopts a systems approach to understand how oral hygiene operates in real-world contexts, and how interactions between capability, environment, tools, and behaviour shape practice in independent living older adults.

A mixed-methods design was used, combining unique in-home video recording of oral hygiene tasks, motion analysis, ergonomic strain assessment, dexterity testing, and qualitative interviews. Independent adults (n=24) were recorded brushing their teeth in their own bathrooms using mounted cameras. Brushing sequences, duration, and coverage were analysed alongside ergonomic exposure using Rapid Upper Limb Assessment (RULA) and the Revised Strain Index (RSI). Plaque distribution was measured using the Turesky Plaque Index. Semi-structured interviews explored routines, adaptations, and lived experiences.

Findings demonstrate that oral hygiene operates as an adaptive system rather than a fixed routine. Distinct behavioural profiles based on participants' functional ability became visible, where some participants traded reduced ergonomic strain for simplified, less efficient brushing strategies. These adaptations appeared to maintain routine continuity while reflecting underlying constraints in strength, dexterity, and access. Interview data indicated that routines were often established earlier in life and not fully adjusted to current capability.

This unique in-home observational and analytical approach provides new insight into how oral hygiene is actually performed, revealing adaptations and constraints that are not captured through conventional outcome-based measures, and creating new opportunities to study, design, and improve everyday oral hygiene practices.

Association of Metabolic Syndrome with Compositional and Functional Differences in the Root Canal Microbiome of Apical Periodontitis

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Abstract

Background: Apical periodontitis (AP) is an inflammatory disease characterised by polymicrobial root canal infections. Although the root canal microbiome is considered essential to AP pathogenesis, how host systemic factors, particularly metabolic conditions, shape this infection-associated community remains insufficiently understood. This study investigated the associations between host metabolic status and the taxonomic composition, ecological structure, functional capacity, and genomic variation of the infected root canal microbiome.

Methods: Root canal samples were collected from 43 patients with apical periodontitis (AP), including 26 patients with metabolic syndrome (MetS) and 17 without MetS (non-MetS). All samples underwent shotgun metagenomic sequencing. Taxonomic and functional profiling, differential abundance testing, co-occurrence network analysis, and strain-level genomic characterisation of the key taxa were performed.

Results: While overall bacterial diversity was similar between the two groups, metabolic condition contributed modestly but significantly to the compositional variation. *Enterococcus casseliflavus* was significantly enriched in non-MetS samples, whereas *Bifidobacterium psychraerophilum* was significantly enriched in MetS samples. Compared with the non-MetS group, the MetS-associated microbiome displayed a more coordinated microbial community, characterised by a co-occurrence network with higher density and fewer negative correlations. Functional pathways related to carbohydrate, amino acid, and lipid metabolism differed between groups, with changes in functional potential observed in key taxa. Strain-level analysis revealed genomic divergence in *E. casseliflavus* between groups, including recurrent non-synonymous mutations in phosphotransferase system genes (K02761) enriched under MetS. Integration of host serum metabolomics further revealed distinct association patterns linking microbial abundance and post-treatment metabolic alterations in MetS and non-MetS groups. Additionally, fungal, archaeal, and viral taxa also showed differential prevalence patterns between groups.

Conclusion: Host metabolic condition is associated with multi-aspect differences in the AP-associated root canal microbiome, suggesting that systemic metabolic status may influence endodontic disease ecology, AP pathophysiology, and treatment responses.

Anxiety and Fear of Disease Progression Among Oral Dysplasia Patients

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Abstract

Objectives To investigate the psychological impact of an Oral Potentially Malignant Disorder (OPMD) diagnosis and to explore patients' awareness of the malignant risks and their coping mechanisms.

Methodology: A retrospective cohort study of patients under long-term review for OPMD. Participants completed a Fear of Disease Progression (FoDP) questionnaire and a Hospital Anxiety and Depression Scale (HADS).

Results

There were 150 participants (92.7% of all eligible) including 72 females and 67 males with a mean age of 67.3 ± 11.6 years (range 40–93 years) with a diagnosis of mild dysplasia (51%), moderate dysplasia (33%), severe dysplasia (12%), and lichen planus (4%).

According to the HADS half of the participants scored normal levels of anxiety, while 18% reported mild anxiety and 32% moderate to severe anxiety. In contrast the FoDP indicated that 35% had no anxiety about their oral condition and of the remainder 32% were mildly anxious, 24% were moderately anxious, 7% were very anxious, and 2% were extremely anxious. Regarding understanding of their condition, approximately 33% of participants understood their diagnosis as pre-cancerous, while 46% believed it was cancer and 23% were unsure or unable to recall the information provided. Only 30% were aware of the potential for malignant transformation. Additionally, 18% reported that the diagnosis had led to significant changes in their lives, 18% reported thinking about the condition often, while 8% did so a lot. Self-examination was carried out rarely in 18% and never in 16%. Twenty-seven percent experienced negative thoughts, and common coping strategies included exercise, yoga, meditation, and spending time with family and friends.

Conclusion

This study highlights significant anxiety and its impact on quality of life. Variability exists in patient understanding, awareness and coping strategies. Future research is required to develop interventions to support and educate patients with OPMD.

Toothful: Co-designing a positive health resource for adolescent orthodontic patients.

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Abstract

Background: Current approaches to oral hygiene support with adolescent orthodontic patients are primarily directive, emphasising the risks of poor oral hygiene and seeking compliance with instructions. This doesn't engage young peoples' desire for nice teeth that motivates them to seek orthodontic care.

The aim of this research was to explore the potential for positive health approaches on this care pathway.

Methods: The research approach was guided by self-determination theory using an interpretative paradigm, firstly systematically reviewing the evidence for current approaches and secondly exploring young people's perspectives of their motivation and how this can be supported on orthodontic care pathways through qualitative interviews and thematic analysis. To translate research insights into practice, a co-design project with visual communication students developed 'Toothful', a new resource tailored to adolescent orthodontic patients focused on the user experience.

Results: Rather than being a chore, adolescent research participants reported self-concordant motivation and positive emotions associated with toothbrushing aligned with meaning, purpose and accomplishment. Using design thinking, we synthesised evidence, theory, and patient perspectives through workshops to create prototype resources promoting health literacy through a meliotropic, positive health approach. These will be evaluated by the research participants.

Discussion: Design thinking creates an opportunity to enhance care pathways and health literacy through an interdisciplinary process of innovation, engaging patients as key stakeholders in the process. Positive health sciences can inform health promotion resources that enhance wellbeing through reframing healthy behaviours, creating supportive environments that build autonomy, positive emotions and sustainable health behaviours to enhance population health.

The Assessment of The Volumetric Occlusal Adjustments Required for Michigan Splints Fabricated Using Various Digital Bite Registrations

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Abstract

Abstract

Objective:

To assess the volumetric occlusal adjustments required for Michigan splints fabricated using different digital bite registration workflows and to determine which workflow provides the most accurate maxillomandibular relationship at the fit appointment.

Materials and Methods:

This controlled interventional clinical study included 40 healthy adult participants. Digital intraoral scans were obtained for all participants, together with bite registrations in intercuspal position (ICP) and centric relation (CR). A digital facebow (FB) record was also used where applicable. Four digital workflows were evaluated according to the combination of bite registration and facebow transfer. Occlusal splints were digitally designed, 3D printed, polished, and fitted clinically. After intraoral occlusal adjustment, each splint was rescanned. The pre-adjustment and post-adjustment STL files were imported into reverse engineering software and compared using three-dimensional analysis. The volume of occlusal modification was quantified using root mean square (RMS) deviation values. Statistical analysis was performed to compare the volumetric changes among groups.

Results:

The workflow using centric relation with digital facebow transfer required the least volumetric occlusal adjustment at the fit appointment, indicating the highest level of accuracy among the tested methods. Splints fabricated using the other workflows required greater modifications, reflecting less accurate transfer of the maxillomandibular relationship. These findings suggest that both the recording position and the use of digital facebow transfer influence the clinical fit of digitally fabricated Michigan splints.

Conclusion:

Within the limitations of this study, centric relation combined with digital facebow transfer produced the most accurate digital workflow for fabrication of Michigan splints, as demonstrated by the smallest amount of occlusal adjustment required clinically. This approach may improve the precision of splint fabrication and reduce chairside adjustment time in digital prosthodontic practice.

Keywords:

Digital dentistry, Michigan splint, centric relation, digital facebow, bite registration, virtual articulator

From Tubule Occlusion to Gingival-Tissue Safety: Human Gingival Keratinocytes Responses to Bioactive Glasses for Treating Dentine Hypersensitivity

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Abstract

Objectives:

Dentine hypersensitivity (DH) is a widespread, painful dental condition that can be alleviated using bioactive glass (BG)-containing toothpastes. Upon interaction with saliva, BGs can dissolve and release ions, leading to occlusion of exposed dentinal tubules through apatite formation on the tooth surface and within tubules. This mechanism contributes to symptom relief; however, the effects of released ions on gingival tissues remain under-explored. This study looks at the effects of three BG compositions on h-TERT immortalised human gingival keratinocytes (TIGKs) to assess their safety for gingival tissue.

Methods:

To investigate TIGKs responses to 45S5 ($\text{SiO}_2\text{-CaO-P}_2\text{O}_5\text{-Na}_2\text{O}$), BioMinF ($\text{SiO}_2\text{-CaO-P}_2\text{O}_5\text{-Na}_2\text{O-CaF}_2$) and MY07 ($\text{SiO}_2\text{-CaO-P}_2\text{O}_5\text{-CaCl}_2$), conditioned media were prepared by incubating glass powders in Dermalife-K culture medium at 37 °C for 24 h. Resulting extracts were filtered and diluted 1:4 and 1:16. TIGK viability, metabolic activity and proliferation were assessed after 1, 3 and 7 days of exposure to BG extracts.

Results:

Exposure to undiluted 45S5 and BioMinF extracts at 50 mg/ml was cytotoxic, with significantly reduced TIGK metabolic activity and cell number compared with untreated control, whereas MY07 maintained high cell viability over 7 days. This cytotoxicity is likely attributable to excessive alkalinity and high ion concentrations, particularly sodium. At more clinically relevant concentration (1.5 mg/ml) and higher dilutions, all BG extracts showed high TIGK viability comparable to untreated cells, indicating a composition- and concentration-dependent safety profile.

Conclusions:

By evaluating gingival keratinocyte responses, this study addresses an under-explored aspect of bioactive glass use in dentine hypersensitivity and provides new safety data relevant to soft tissue exposure. Based on the findings, MY07 showed the most promising safety profile, suggesting improved potential for safer clinical application. Future work will include longer-term exposures, Zonula Occludens-1 staining and IL-6 measurement to assess epithelial integrity and inflammatory responses.

Supporting guidance implementation: practitioner perspectives on child caries management

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Abstract

Background:

The Scottish Dental Clinical Effectiveness Programme (SDCEP) published the third edition of *Prevention and Management of Dental Caries in Children* in February 2025. The updated guidance contains three areas where the guidance has changed due to new evidence or clinical developments: the use of silver diamine fluoride (SDF) as a caries management option, the use of preventive fissure sealants, and pulpotomy as a treatment option for irreversible pulpitis in a permanent tooth. To support the future implementation of the guidance, questionnaires were developed to explore dental practitioners' behaviours and beliefs.

Methods:

An online questionnaire was distributed to dentists, dental therapists, and dental hygienists working in Scotland one month before the guidance was published. A second questionnaire was distributed nine months after publication. The questionnaires comprised sections covering current practice and beliefs related to fissure sealants, SDF and pulpotomy. Belief questions were informed by the COM-B model of behaviour. Quantitative data were analysed using descriptive statistics, and qualitative data were analysed thematically.

Results:

A total of 131 practitioners responded to the pre-publication questionnaire; 55 responded to the post-publication questionnaire. Before publication, respondents reported they had the capability, opportunity, and motivation to consider individual patient factors when placing fissure sealants. In contrast, most respondents reported limited use of SDF and pulpotomy in permanent teeth and responses related to capability, opportunity and motivation were mixed. Barriers to both included insufficient training, access to materials, and remuneration. Post-publication, use of SDF and pulpotomy had increased slightly although barriers persisted. While capability and opportunity remained mixed, motivation had increased for both behaviours.

Conclusions:

Results have highlighted that following the publication of the updated SDCEP guidance, use of SDF and pulpotomy remains limited. Although post-publication motivation increased, persistent barriers suggest that additional training and practical supporting resources are needed to support implementation in practice.

“It felt like the only real option”: parental decision-making for paediatric dental general anaesthesia — a qualitative study using the Theoretical Domains Framework

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Abstract

Objectives:

Dental general anaesthesia (DGA) is commonly used to manage children with advanced dental disease in the UK, yet how parents make decisions at the point of consent remains poorly understood. This study examined parental decision-making following consent for DGA and identified key influencing factors.

Methods:

A qualitative interview study was conducted in a UK hospital-based paediatric dental service. Parents of children with a confirmed treatment plan for DGA and documented consent were recruited. Semi-structured interviews were undertaken post-consent and before treatment. Interviews were audio-recorded, transcribed verbatim, and analysed using a framework approach, with data mapped to Theoretical Domains Framework (TDF) domains.

Results:

Sixteen parents and two children participated; however, children's contributions were minimal. Decision-making extended beyond the point of consent. Influences mapped across key domains. *Environmental context and resources* (limited access to primary care, long waiting times) constrained options, leading parents to view DGA as the only realistic means of securing treatment. *Memory, attention and decision processes* reflected decisions made in busy clinical settings, with limited time and capacity to process information. Within *knowledge*, parents reported partial understanding and relied on clinician explanations. *Emotion* (anxiety about anaesthesia, concern about the child's symptoms) contributed to urgency in decision-making. *Social and professional role and identity*, and *social influences*, indicated that parents recognised their responsibility but relied on clinician expertise when unable to appraise the situation independently. *Reinforcement* from previous unsuccessful dental experiences further supported acceptance of DGA. Consent was frequently described as provisional, with ongoing reflection after the consultation.

Conclusions:

Parental decision-making for paediatric DGA is shaped by constrained choices, emotional pressure, and reliance on clinician guidance. Decisions are often made to secure timely care rather than through comparison of options, and continue to evolve after the consent discussion. These findings highlight the need to support decision-making across the care pathway.

Mechanical and Educational Evaluation of Multi-Material 3D-Printed Tooth Models for Pre-Clinical Dental Training

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Abstract

Objective

Conventional typodont teeth and single-material resin models used in pre-clinical dental education do not adequately replicate the structural or mechanical properties of natural enamel and dentine. This study aimed to develop multi-material 3D-printed tooth models and evaluate their mechanical performance and educational value, including user feedback on tactile realism and clinical handling.

Materials and Methods

Tooth models were fabricated using stereolithography (SLA) (Formlabs) and PolyJet technology (Stratasys J5). Eleven photopolymer resins were investigated. Material characterisation included Vickers hardness, Mohs hardness, surface roughness, and scanning electron microscopy (SEM). Cutting performance was assessed using a custom setup simulating clinical instrumentation under a controlled 150 g load.

Educational evaluation was conducted with 62 participants (undergraduate and postgraduate students and academic staff) using structured questionnaires to assess tactile realism, debris removal, canal instrumentation, and overall suitability for training (Ethics Ref: 064036).

Results

A high glass-filled resin demonstrated dentine-like mechanical behaviour, while ceramic-reinforced and provisional crown resins exhibited enamel-like hardness and cutting response. Alumina N4 showed excessive brittleness and poor cutting characteristics. Printing orientation significantly influenced canal integrity, with a 0° orientation minimising apical obstruction.

Participant feedback indicated improved performance compared to conventional plastic teeth. Over 80% of participants rated debris removal as acceptable, and most reported minimal or no canal transportation during instrumentation. Tactile realism during cutting and preparation was rated as similar or superior to traditional typodont models, with participants highlighting the realistic transition between enamel and dentine. Limitations were identified in the pulp analogue, particularly regarding removal characteristics.

Conclusion

Multi-material 3D printing enables the development of tooth models with improved mechanical behaviour and enhanced educational realism. These models demonstrate strong potential as an alternative to conventional typodont teeth in pre-clinical dental training.

The Mucosal Pellicle and Nanoparticles: A Potential Route to Keep Oral Actives Working in our Mouths for Longer?

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Abstract

The mucosal pellicle (MP) is a dynamic, gel-like layer lining the oral epithelium, consisting of mucins – large, highly glycosylated, negatively charged proteins secreted from minor salivary glands. Oral actives (OAs) such as sodium fluoride, stannous fluoride, and chlorhexidine are found in many existing dental products, reducing dissolution and promoting repair of enamel, alongside antimicrobial activity against cariogenic bacteria. OAs show poor retention in the mouth. The MP could serve as a reservoir for these OAs in the mouth, allowing them to function for longer. This project aims to develop a high-throughput model MP and use it to optimize OA retention.

The model MP was formed by drying a thin film of bovine submaxillary mucin (BSM) to a 96-well plate. After washing and re-hydration, the film was stained and confocal images taken. Nanoparticles of different sizes and charges were incubated on the model MP. Their retention and release were measured by fluorometry. Positively charged chitosan nanoparticles were formed and characterized. Fluoride was applied to the MP and its release detected using an ion-selective electrode.

Model MP formation was successfully optimized for over 80% (± 4.28) mucin retention, forming a ~ 60 μm -thick layer lining the plate, showing little protein loss after 27 washes. Fluorescent nanoparticles displayed bi-phasic release ($t_{1/2}=1.5\text{min}$ from 0-15mins, and $t_{1/2}=4\text{min}$ from 15-60mins). Positively charged chitosan nanoparticles were conjugated to fluorescent probes, forming 100-1000nm spherical particles. Preliminary experiments showed low fluoride retention in the model MP.

In conclusion, the novel model MP displayed good retention, resistance to washing, and morphology. Nanoparticles were successfully retained and released from the mucin film over 60 min. Low fluoride retention on the MP points to a need for additives to optimize its retention. Mucoadhesive chitosan nanoparticles have the potential to be loaded with fluoride, allowing them to be retained and release fluoride over longer time-periods.

Cariostatic Properties of Zinc tetraammine difluoride and Silver diammine fluoride: An ISE and SS-NMR Studies

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Abstract

Objective: To investigate the cariostatic mechanisms of zinc, silver, and fluoride containing compounds on the demineralisation of hydroxyapatite using NMR and real-time ISE

Methods: Hydroxyapatite (Hap) discs (n=18) were demineralised for 4 hours at 37°C in 50mL of 0.1M acetic acid buffered to pH4.0. The discs were then removed and treated topically for 1min using a micro-brush with one of the following agents: 3.16M zinc chloride, 3.16M zinc nitrate, 3.16M silver nitrate, silver fluoride (Riva Star Aqua, SDI), silver diammine fluoride (Riva Star, SDI), or zinc tetraammine difluoride (SDI). The discs were subsequently returned to the same demineralising solution for an additional 8 hours. Ion-selective electrodes (ISEs) were used to monitor Ca^{2+} concentrations in real-time throughout the experiment. Cariostatic effect was expressed as percentage reduction in calcium loss rate (PRCL) before and after treatment. All experiments were performed in triplicate. In addition, ^{31}P and ^{19}F NMR spectroscopy was performed on treated HAp to characterise reaction products.

Results: Zinc chloride demonstrated a mean PRCL of $70.47 \pm 7.64\%$, while zinc nitrate produced $62.00 \pm 12.76\%$ inhibition. Silver nitrate exhibited a lower inhibitory effect of $47.43 \pm 18.36\%$. Fluoride-containing agents demonstrated substantially greater inhibition of demineralisation: silver fluoride achieved $87.82 \pm 4.76\%$, silver diamine fluoride achieved $81.38 \pm 10.30\%$, and zinc tetraammine difluoride demonstrated the highest inhibition at $92.57 \pm 0.40\%$. NMR analysis of zinc tetraammine difluoride and silver diamine fluoride samples demonstrated similar spectral behaviour, with evidence consistent with fluoroapatite formation following treatment.

Conclusion: Zinc and fluoride have a synergistic effect of reducing HAp demineralisation. NMR findings suggest that zinc tetraammine difluoride promote the formation of fluoroapatite similar to silver diamine fluoride which may contribute to its anti-demineralisation properties.

Effectiveness of Community-based Oral Health Behaviour Change Interventions – a systematic literature review and meta-analysis

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Abstract

Community-based behaviour-change interventions offer a scalable preventive approach to improve oral health (OH), yet evidence on effective strategies for adults, particularly from ethnic minority and migrant backgrounds, remains limited. This review aimed to: a) determine effectiveness of community-based OH behaviour-change interventions; b) identify behaviour-change techniques (BCTs) used, and; c) characterise the BCT profile of interventions targeted to ethnic minority and migrant populations.

This PROSPERO-registered review (CRD420251003461) searched Medline, CENTRAL, CINAHL, Scopus, and PsycInfo (2000 to April 2025). Eligible studies targeted OH behaviour change in adults aged ≥ 16 . Effectiveness was narratively synthesised for knowledge and OH behaviours. BCTs were coded using BCT Taxonomy v1 and mapped onto the COM-B model. A random-effects meta-analysis was conducted for plaque index outcomes. Risk of bias was assessed using RoB-2 and ROBINS-I.

Of 8,390 articles screened, 47 studies across 16 countries were included. Knowledge improved in 86% of studies reporting this outcome, and behaviours such as toothbrushing, flossing, and tobacco cessation improved in 85%. Most frequently coded BCTs were: 4.1 Instruction on how to perform a behaviour (n=41), 5.1 Information about health consequences (n=26) and 7.1 Prompts/ cues (n=20). Eight culturally and linguistically tailored interventions targeted ethnic minority and migrant communities; of which seven were effective. Effective interventions employed self-regulatory BCTs including 1.4 Action Planning, 1.2 Problem solving, and 2.2 Feedback on behaviour; mapping to reflective motivation and psychological capability. Plaque index meta-analysis (n=5) yielded a non-significant pooled SMD of -2.68 (95% CI -5.85 to 0.49; $I^2 = 99.8\%$).

Community-based OH interventions improve knowledge and behaviour, but whether this translates to sustained behaviour change and clinical improvement remains uncertain. Culturally tailored interventions delivered by lay health advisors and incorporating self-regulatory BCTs show promise particularly for ethnic minority and migrant populations. Future research should prioritise standardizing outcome measures, longer follow-up, and meta-regression to test BCT-effectiveness associations.

Developmental Evidence for the Evolutionary Origins of the Mammalian TMJ Disc

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Abstract

The mammalian jaw joint between the dentary bone of the lower jaw and the squamosal/temporal bone of the upper jaw is a mammalian evolutionary innovation that enables complex movements essential for chewing and speaking. It comprises the mandibular condyle, the glenoid fossa, and a fibrocartilaginous disc. The disc is critical for joint function, and its pathology underlies temporomandibular disorders, which can affect up to a third of adult and elderly patients. The mammalian jaw joint is proposed to have evolved to stabilize the primary jaw joint, found in all non-mammalian jawed vertebrates, acting as a buttress for the lower jaw against the upper to prevent jaw dislocation. The origin of the disc is less understood, but it has been hypothesized to have evolved either from the top layers of the fibrocartilaginous condyle, or as an independent structure, potentially evolved from an existing tendon.

To resolve these relationships, the condyle and disc were analysed during murine development to shed light on their molecular and cellular identity during formation of the joint. Using Bulk RNA-seq we demonstrate that the forming temporomandibular joint (TMJ) disc exhibited a developmental trajectory distinct from that of the mandibular condyle, with *Lgr5* expression serving as a marker of the developing disc from early developmental stages. Clonal tracing of cells at the interface between the condyle and disc, using *Pcag-CreER*;Confetti mice, further demonstrated that the disc cells formed a distinct compartment compared to the superficial layers of the condyle. Notably, disc identity was preserved in *Wnt1-Cre*;Sox9^{fl/fl} mutants where the condyle failed to form.

Together, these findings establish the TMJ disc as having a distinct molecular and cellular identity, initiating independently from the condyle, while sharing many features with a tendon. Together these findings support the TMJ disc as evolving from a tendon rather than the condyle.

A Clinical Study to Evaluate the Efficacy of CPC Mouthwash in Improving Gingival Health and Reducing Plaque Accumulation

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Abstract

Background: The use of antimicrobial mouthwash as an adjunct to mechanical oral hygiene can enhance plaque removal and improve gingival health. Cetylpyridinium chloride (CPC) is a well-established antimicrobial agent; however, clinical data on higher-concentration CPC mouthwash formulations used in combination with a regular fluoride toothpaste remain limited.

Methods: This single-centre, 12-week, randomised, controlled, examiner-blind, parallel-group clinical study was conducted in adults with plaque-induced gingivitis. Following washout and full-mouth prophylaxis, 136 participants were randomised to twice-daily brushing with a regular fluoride toothpaste alone (0.243% w/w NaF; negative control) for one minute or brushing with the same toothpaste followed by 30-second rinse with an experimental CPC mouthwash (0.085% w/w; test product). Clinical assessments were conducted at baseline, Week 6, and Week 12. Clinical endpoints included overall and interproximal Number of Bleeding Sites (NBS), Expanded Bleeding Index (EBI), Modified Gingival Index (MGI), and Turesky Plaque Index (TPI).

Results: 131 participants completed the study. Compared with toothpaste alone (negative control), the toothpaste/mouthwash (test product) group demonstrated statistically significant reductions in overall and interproximal NBS at Weeks 6 and 12 ($p < 0.0001$). Significant improvements favoring the toothpaste/mouthwash group were also observed for overall and interproximal EBI ($p < 0.0001$), MGI ($p < 0.0001$), and TPI (overall $p < 0.0001$; interproximal $p \leq 0.0002$) at both timepoints. This indicates consistent benefits across clinical measures of gingival inflammation and plaque accumulation. All study products were well tolerated, with no serious adverse event reported.

Conclusions: This study demonstrated that use of an experimental 0.085% CPC mouthwash following twice-daily brushing with regular fluoride toothpaste resulted in significant improvements in gingival bleeding and plaque accumulation compared with use of regular fluoride toothpaste in a population with localized gingivitis. These findings support the role of CPC mouthwash as an adjunct to toothbrushing alone in improving gum health.

Development and Characterisation of Hierarchical Fluorapatite Glass-ceramic Materials

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Abstract

The development of restorative materials that replicate the hierarchical structure and functional behaviour of natural enamel remains a major challenge in dental biomaterials research. Conventional glass-ceramics, though chemically compatible, often lack the microstructural organisation and balance of mechanical properties required for durable clinical performance. Our study presents the design and fabrication, and characterisation of a novel fluorapatite-based glass-ceramic engineered to mimic the structure-function relationship of human dental enamel.

Four glass compositions with varying Ca/F ratios were synthesised and subjected to differential scanning calorimetry, thermal optimisation, and systematic heat-treatment protocols. Intensive structural and microstructural characterisation was carried out using X-ray diffraction, secondary ion mass spectrometry, scanning electron microscopy, scanning transmission electron microscopy, and transmission electron microscopy with energy-dispersive X-ray spectroscopy. Together, these methods enabled precise evaluation of crystallisation pathways, phases formation, and microstructural organisation, thereby identifying the most promising composition for further optimisation. The highest fluorine content of the four compositions demonstrated the most promising crystallisation behaviour, yielding a microstructure composed of fluorapatite nanocrystals arranged in an organised spherulitic microstructure resembling enamel prisms. Optimisation of the thermal treatment process enabled control of both surface and bulk crystallisation, thereby achieving a hierarchical organisation absent in previously reported systems.

This work highlights the development and structural characterisation of a novel fluorapatite-based glass-ceramic system.

Vitamin D Reprograms Macrophage Immunophenotype and Inflammatory Responses to *Porphyromonas gingivalis*

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Abstract

Objectives

To investigate how 1,25-dihydroxyvitamin D₃ (1,25(OH)₂D₃) modulates macrophage inflammatory responses and immunoregulatory pathways during *P. gingivalis* infection.

Materials & Methods

THP-1-derived macrophages were pretreated with 1,25(OH)₂D₃ (1–100 nM) for 24 h, followed by infection with *P. gingivalis* W50 (MOI 100). Gene expression of inflammatory cytokines (IL6, TNFA, CXCL8), pattern recognition receptors (TLR2, TLR4), macrophage polarization markers (CCR7, CD206), and vitamin D receptor (VDR) was analyzed by real-time qPCR after 6 h. Cytokine secretion (IL-1β, IL-6, IL-8, TNF-α) was quantified by ELISA after 24 h. Mutant strains lacking virulence factors (EK18, PorR) were used to assess pathogen-dependent effects.

Results

Vitamin D pretreatment enhanced *P. gingivalis*-induced cytokine secretion, as evidenced by increased levels of IL-1β, IL-6, IL-8, and TNF-α.

At the transcriptional level, vitamin D also upregulated the expression of IL6, TNFA, and CXCL8. This was accompanied by differential modulation of pattern recognition receptors, with increased TLR2 expression and decreased TLR4 expression.

In parallel, macrophage polarization markers were altered, with reduced CCR7 and increased CD206 expression, suggesting a shift toward a mixed immunoregulatory phenotype. VDR expression was reduced following vitamin D treatment and bacterial challenge, suggesting potential feedback regulation of vitamin D signaling.

Furthermore, the magnitude of cytokine modulation varied in response to virulence factor-deficient strains, indicating a pathogen-dependent regulatory mechanism.

Conclusion

Vitamin D reprograms macrophage responses to *P. gingivalis* by enhancing inflammatory cytokine production while simultaneously modulating pattern recognition and polarization pathways.

Rather than acting solely as an anti-inflammatory agent, vitamin D promotes a balanced immunophenotype integrating pro-inflammatory activation with regulatory features. This context-dependent immunomodulation highlights its potential as a precision host-directed therapeutic strategy in periodontitis.

Exploring the Biocompatibility and Biomineralization Properties of African Plant Extract for Regenerative Endodontics

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Abstract

Objectives: To evaluate the effect of African Plant Extract (APE) on the viability, proliferation, and mineralization of Dental Pulp Stem Cells (DPSCs), with a view to use in future pulp-dentin complex regeneration in regenerative endodontics applications.

Methods: DPSCs (passages 4 - 8) were seeded in 6-well plates (n = 3 per group and experiments were repeated from 3 different donors) and exposed to three concentrations of APE (5, 10, and 15 µg/mL), in comparison to an untreated control. Cell viability was assessed using Live/Dead staining and confocal microscope imaging, and proliferation rate was measured (WST-1 assay) at 24 hours, 3 days, and 7 days. Mineralization capacity in the presence and absence of APE was evaluated by Alizarin Red Stain (ARS) and quantitative analysis at 14 and 28 days.

Results: High cell viability was observed in all groups with no evidence of cytotoxicity at all 3 timepoints. Cell proliferation was similar across groups at 24 hours but increased progressively at 3 and 7 days, with the 10 µg/mL group showing the highest proliferation rate. ARS confirmed mineralized nodule formation by DPSCs. ARS quantitative analysis showed time-dependent increase in mineralization across all groups. At 14 days, the 15 µg/mL group had the highest calcium deposition among the APE-treated groups, while by 28 days the 10 µg/mL group showed the highest mineralization response.

Conclusion and Future Work: We have confirmed the biocompatibility and ability of APE to induce mineralization in DPSCs. Further studies are needed to assess the antimicrobial and anti-inflammatory activities of APE, and the ability to drive pulp-dentin complex differentiation and regeneration with DPSCs.

Secondary dentine as an age evaluation index in teeth with or without attrition.

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Abstract

This research aimed to assess the correlation between the age of both males and females and the surface area of secondary dentin (SD) in the transverse ground section of human teeth with and without occlusal attrition. Eighty extracted sound teeth were allocated into four groups: Group I, 20 teeth without occlusal attrition from male patients; Group II, 20 teeth without occlusal attrition from female patients; Group III, 20 teeth with occlusal attrition from males; Group IV, 20 teeth with occlusal attrition from females. Later, transverse sections at the cervical third of each tooth root were prepared and examined. The correlation between the surface area of SD and the actual age together with patients' sex was determined utilizing Pearson's correlation coefficient. Linear regression was also calculated to study the relationship between the SD surface areas as a predictor of patients' age. From the obtained data, the chronological age was statistically significant, with a surface area of SD among all groups. The females showed a strong correlation, and the males showed a non-significant correlation between the chronological age and SD surface area. As well as, both teeth with occlusal attrition and those without occlusal attrition demonstrated a strong correlation between surface area and chronological age. The current research has highlighted the viability of using SD for age estimation in Egyptian adults for both sexes; however, the teeth showed occlusal attrition. Also, using the regression equations developed from this study specific to the sex and the tooth condition, dental age can be estimated by measuring the SD surface area from the histologic ground section.

How Can We Do Better? A Qualitative Exploration of the Views of Patients with Lived Experience of Domestic Abuse on Their Perceptions of the Ability of Dental Teams to Respond to Disclosure and Offer Support

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Abstract

Domestic abuse (DA) is a prevalent public health issue which affects one in three British women within their lifetime, with long-term physical and psychosocial consequences. As approximately 97% DA-related injuries involve the head and neck, dentists are likely to encounter patients with lived experience. Understanding survivor perspectives is essential for trauma informed dental practices.

The aim of this study was to explore the views of patients with lived experience of DA on the involvement of the dental team in disclosure and support.

This study used a qualitative design with semi-structured interviews with adults who have experienced DA. Participants were recruited through community sector organisations and word of mouth. Data was collected in person or online. Thematic analysis was used to analyse the data and identify recurrent themes using the model proposed by Braun and Clarke.

Twenty individuals were recruited. Participants described disclosure within dental settings as complicated, with many participants having experienced re-traumatisation and developed avoidance behaviours as a direct result of visiting a dentist. Key themes included the importance of trust and an emphasis on the need for dentists to be taught trauma informed practice and communication. Barriers to disclosure included fear of inappropriate responses, lack of confidence in a dental professional's training, and prior negative experiences with healthcare professionals. Many participants were unaware that dental teams are supposed to be trained to offer support, highlighting a lack of visibility and signposting. Despite this dentistry was viewed as having potential to contribute to recovery when care was delivered appropriately.

Dental teams are well positioned to support individuals experiencing DA, inline with GDC guidelines, but this does not align with patient experiences. This study highlights the need for better training, signposting, and trauma informed care. Improving communication, safety and awareness may facilitate disclosures and contribute to better long-term outcomes for survivors.

From Surface Design to Cell Behaviour: Hybrid P₁₁-4/HA Titanium Coatings in an Osteoporotic Environment

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Abstract

Objective:

To develop and characterise a novel hybrid coating for titanium (Ti) implant surfaces combining self-assembling peptide (SAP) P₁₁-4 with hydroxyapatite (HA) to enhance osseointegration under osteoporotic conditions.

Methods:

Twelve acid-etched Ti discs were divided into four groups: uncoated Ti, HA-coated, P₁₁-4-coated, and hybrid P₁₁-4/HA-coated. Surface chemistry and morphology were analysed using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), energy-dispersive X-ray spectroscopy (EDX), and field-emission scanning electron microscopy (FESEM). Surface roughness and wettability were evaluated using profilometry and water contact angle (WCA) measurements. Periodontal ligament stromal cells (PDLSCs) from three healthy donors were used to assess viability via live/dead staining and cytotoxicity using LDH assay. Osteogenic differentiation was assessed using Alizarin Red staining and quantitative assays in PDLSCs from both healthy and postmenopausal osteoporotic donors.

Results:

XRD, EDX, and FTIR confirmed the presence of hydroxyapatite and brushite phases. FTIR identified hierarchical β -sheet structures at 1625 cm⁻¹ and 1682 cm⁻¹. Coated surfaces exhibited significantly greater roughness than uncoated Ti (1.379 $\pm$ 0.533 μ m), with P₁₁-4/HA showing the highest (28.55 $\pm$ 0.708 μ m), followed by HA and P₁₁-4. Wettability improved markedly, with WCA decreasing from 70.0° to 36.0° in the P₁₁-4 group, while rapid droplet absorption occurred in the hybrid coating. FESEM revealed uniform laminar peptide structures, needle-like HA crystals, and modified morphology in hybrid coatings. P₁₁-4 showed the highest cell viability (95.58 $\pm$ 1.7%), while HA showed the lowest, with intermediate viability observed for the hybrid coating (84.42 $\pm$ 15.0%). LDH assay indicated minimal cytotoxicity (<5%) across all groups. HA and hybrid P₁₁-4/HA coatings produced the most significant mineralisation at 14 and 28 days in both OP and healthy donors.

Conclusion:

Hybrid P₁₁-4/HA coatings combine favourable surface properties with cytocompatibility and enhanced mineralisation, supporting their potential to improve Ti implant osseointegration, particularly in patients with compromised bone healing such as osteoporosis.

Assessing erosive subsurface enamel damage with Optical Coherence Tomography: uses and limitations

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Abstract

Erosive tooth wear damages enamel through the combined action of non-bacterial acids and mechanical forces, with evidence suggesting damage can reach subsurface enamel layers at early stages. Optical coherence tomography (OCT) may offer a non-invasive method to quantify this subsurface change.

The objective was to evaluate if OCT was sufficiently sensitive to quantify subsurface enamel change in samples undergoing erosion *in vitro*.

Human enamel specimens (n=10) were sectioned from previously extracted molars (REC 25/EE/0020). Repeatability and reproducibility were assessed by scanning a single surface 10 times in the same position (repeatability) then repositioning in between (reproducibility) using a swept-source OCT system (VivoSight Topical, Michelson Diagnostics Ltd., Maidstone, UK). A further 50 samples were scanned at baseline, then immersed in 0.3 % w/v citric acid solution (pH 2.70) for 5, 10, 15, or 20 minutes, or water control, and rescanned. Attenuation coefficient change (CV, mm⁻¹) was calculated by subtracting post-scan readings from baseline. Data were normal, paired t-tests and post-hoc Bonferroni correction were applied.

Repeatability and reproducibility values for attenuation coefficient change of OCT were -0.08 ± 0.19 and -0.12 ± 0.52 mm⁻¹ (CV: 9.7% and 22.7%), respectively. The mean attenuation coefficient change was 0.19 (0.56) after 5min, 0.15 (0.31) after 10min, 0.67 (0.56) after 15min and 1.10 (0.46) after 20min with large standard deviations. Statistical differences between baseline and eroded enamel were detected at 15 (p = 0.021) and 20 minutes (p < 0.001). Attenuation coefficient change at 5 and 10 minutes were within the error of the system.

Poor repeatability and reproducibility, even under ideal conditions, resulted in limited sensitivity of OCT for early erosion. While statistical changes were observed after 15 and 20 minutes on polished surfaces, further work is required to reduce noise and validate on natural surfaces before being used as a diagnostic tool.

Investigating the oral effects of nicotine pouches: preliminary findings from a patient and professional survey.

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Abstract

Objective:

To investigate the oral and dental impacts of nicotine pouch use through a national survey.

Background:

The use of nicotine pouches (NPs) has increased rapidly, with many individuals using them as a smoking cessation aid. However, little is known about their oral and dental effects or the awareness of users and dental professionals.

Methods:

A national survey was developed and distributed to NP users. Participants were asked about usage patterns and any oral changes noticed since using these products. Responders could also upload photographs of suspected oral lesions. Interim analysis was undertaken.

Results:

A total of 2,265 responses were received, including 2,044 oral nicotine pouch users (1,778 current users; 266 former users). Most respondents were male (91%, n=1,869) and aged 16–25 years (89%, n=1,816). Over half (54%, n=1,111) were in full-time education. Most current users (84%, n=1,718) had used nicotine pouches for between six months and five years.

Overall, 44% of users reported oral or dental changes. The most commonly reported effects were gingival recession/shrinkage (30%, n=622), burning sensations (20%, n=410), white patches (17%, n=314), oral dryness (14%, n=276), and mouth ulcers (9%, n=176).

A small proportion agreed to further follow-up: 2% (n=37) uploaded intra-oral photographs, 8% (n=156) consented to remote home monitoring, and 24% (n=504) agreed to attend an in-person assessment.

Conclusions:

Early findings suggest NP users frequently self-report oral changes. Further remote and in-person monitoring is required to assess oral mucosal changes, including saliva sampling and tissue biopsies.

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Sugar-sweetened beverage consumption of children and young people attending dental settings: A Mixed Methods Study

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Abstract

Background: Sugar-sweetened beverage (SSB) consumption among children and young people (CYP) is high and increasing, with notable inequalities in consumption and associated health outcomes. Frequent intake is associated with dental caries and erosion, type II diabetes, and obesity. Despite this, few studies have investigated SSB consumption specifically within dental settings.

Aims: To investigate SSB consumption levels in CYP attending dental settings and explore the perspectives of stakeholders (CYP, parents/ carers and oral health professionals (OHPs)) in supporting reduction in consumption.

Methods: This mixed-methods study recruited participants (n=263) from dental settings in South Yorkshire and the East Midlands. Quantitative survey data from CYP (n=225) were analysed using descriptive statistics. Qualitative data were gathered through 38 semi-structured interviews with CYP (n=18), caregivers (n=9), and OHPs (n=11), analysed using Framework Analysis.

Results: Consumption was high: 85.8% of CYP consumed SSBs at least weekly, and 33.8% consumed them daily. Carbonated, fruit-based, and sports drinks were most commonly consumed. While 90.1% of CYP recognised the link between SSBs and poor oral health, and 78.7% for general health, consumption was driven by taste, peers, and social media. All stakeholders agreed that OHPs have a vital role in supporting CYP to make healthier choices. CYP identified a conversation with OHPs about SSBs as the most effective way to receive guidance.

Conclusion: Intake of SSBs is high despite awareness of the dental and general health consequences of consumption among some CYP. Future interventions must acknowledge the social and environmental determinants influencing behaviour rather than focusing solely on education. OHP's are well placed to support CYP to make healthier choices. There is a need for co-designed, evidence-based behaviour change interventions tailored to dental settings. This research supports the potential for dental teams to reduce social inequalities in oral health.

Oral Squamous Cell Carcinoma Cells Differentially 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. Alternatively, pro-inflammatory M1-like macrophages, exhibit anti-tumoural effects, respond to environmental changes such as the presence of infection, and tumour-derived signals. The aim of the study was to investigate the effect of OSCC cell conditioned medium on the response of M1 macrophages and whether any responses were also observed in a co-culture system.

Methods: THP-1 pro-monocytes were differentiated to a distinct anti-tumoural macrophage subset and used as a model of tumour associated macrophages. These macrophages were either simultaneously stimulated with conditioned media (CM) from OSCC cells and lipopolysaccharide (LPS) from the oral pathogen *P.gingivalis* or pre-stimulated with the CM then stimulated with LPS. The response of macrophages to OSCC cell lines were then investigated using co-cultures. The resulting supernatant was assayed using sandwich ELISAs to measure the response of secreted cytokines: Tumour Necrosis Factor Alpha (TNF α) and Interleukin (IL-6) to the tumour environmental signals.

Results & conclusion: Macrophage secreted TNF α levels were reduced up to 57% and IL-6 was upregulated up to 100% by simultaneous stimulation by OSCC conditioned media and LPS. In the pre-stimulation condition, there was up to 50% decrease in TNF α , and IL-6 was upregulated by up to 80%. This effect was also observed in a co-culture between macrophages and OSCC cells with a TNF α suppression of 34-85% and a much larger upregulation of IL-6.

Thus, tumour environmental signals and direct cell-cell contact differentially modulate 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 a 3D immunocompetent oral mucosal model.

Early Years Practitioners' Perceptions of a Supervised Toothbrushing (STB) Training Programme in Early Years Settings: A Thematic Analysis of Post-training Feedback from Medway, UK

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Abstract

Title: Early Years Practitioners' Perceptions of a Supervised Toothbrushing (STB) Training Programme in Early Years Settings: A Thematic Analysis of Post-Training Feedback from Medway, UK

Background: Supervised toothbrushing (STB) programmes in early years settings are effective in reducing dental caries and improving oral health behaviours, particularly in deprived communities. Their success, however, depends on practitioner engagement and feasibility in practice. This study analysed post-training feedback to inform improvements to an STB training programme in Medway, UK.

Methods: Electronic evaluations were submitted by 30 of 63 trained practitioners (47.6% response rate). Free-text responses were analysed using a deductive thematic approach, focusing on three areas: most useful elements, least useful elements, and suggested improvements.

Results: Practitioners highly valued informative content that enhanced oral health knowledge, including local oral health context, fluoride guidance, and SEND-appropriate toothpaste use. Practical implementation advice—such as session routines, behaviour management, and video demonstrations—was also seen as particularly beneficial. Hands-on elements increased confidence, and many participants described the training as comprehensive.

The main negative theme was the requirement for participants to brush their own teeth during training, viewed as unnecessary and a poor use of time. Additional minor concerns included scheduling limitations and repetition of previously viewed materials.

Participants recommended removing the personal brushing activity (subsequently actioned), increasing flexibility through virtual or out-of-hours delivery, expanding visual and practical resources (e.g., dental models), providing more local data, clarifying consent messaging, and exploring delivery in pre-nursery settings.

Conclusions: The STB training was perceived as relevant, informative, and practical. Targeted refinements—particularly improving flexibility, removing non-essential components, and enhancing resources—have strengthened its accessibility and alignment with practice needs. Continued improvements are likely to support wider programme uptake and contribute to better oral health outcomes for young children.

Saliva-Mediated Microhardness Assessment of Enamel Erosion Using Remineralising Agents

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Abstract

OBJECTIVES:

To evaluate the saliva-mediated rehardening effects of stannous fluoride (SnF), nanohydroxyapatite (nHAP), nanomicrohydroxyapatite (nmHAP), and a bioactive mint-based formulation (BM) against citric acid (CA)- induced enamel erosion using Vickers surface microhardness assessment.

METHODS:

180 human enamel specimens were randomly divided into 18 groups (n = 10 per group). 160 were assigned to SNF, nHAP, nmHAP, and BM (n = 40 each), subdivided by medium [WMS or DW] and agent application timing (before or after CA), yielding 16 experimental groups. Two negative controls (WMS + CA, DW + CA; n = 10 each) were included. Specimens underwent three erosion cycles: 2 h in WMS or DW, 1 min application (pre- or post-erosion), 10 min in 0.3% citric acid (pH 3.2), and a 2 min DW rinse. Relative surface microhardness change (rSMH%) was calculated using a Vickers microhardness tester and analysed using ANOVA and GLM ($\alpha = 0.05$) with Bonferroni post hoc tests.

RESULTS:

The highest rehardening occurred in nHAP with saliva (WMS–nHAP–CA: 61.42 ± 3.60 ; WMS–CA–nHAP: 61.15 ± 5.34), which was higher than all groups ($P < 0.05$), except BM without saliva (DW–CA–BM: 50.21 ± 8.92) ($P > 0.05$). The lowest rehardening was seen in DW–SnF–CA (32.95 ± 6.66), which was lower than all nHAP except (DW–CA–nHAP), two nmHAP (DW–nmHAP–CA; WMS–CA–nmHAP), and one BM (DW–CA–BM) groups ($P < 0.05$). No differences were found between nmHAP and BM groups ($P > 0.05$). Saliva significantly increased rehardening compared with water ($P < 0.05$), except in BM and SnF groups, while application timing had no effect ($P > 0.05$).

CONCLUSION:

nHAP showed the greatest enamel rehardening, particularly in saliva, with higher rSMH% than all groups except BM without saliva. SnF showed the lowest performance. Saliva improved rehardening overall, except in BM and SnF, and application timing had no effect.

Targeting YAP-TEAD Signalling in Head and Neck Squamous Cell Carcinoma.

Reem Bagabas

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Abstract

Head and neck squamous cell carcinoma (HNSCC) remains a significant clinical challenge, with limited treatment options and poor patient outcomes. Central to tumour progression is the activation of the transcriptional co-regulators YAP (*YAP1*) and TAZ (*WWTR1*), which drive proliferation and survival through TEAD transcription factors. More than 50% of HPV-negative HNSCC patients harbor mutually exclusive *FAT1* loss-of function (LoF) or *YAP1*, *WWTR1*, *TEAD1-4*, or *EGFR* amplifications, all leading to YAP activation. This study aimed to evaluate the therapeutic potential of TEAD inhibition in genetically distinct, YAP-dependent HNSCC subtypes.

Data from the DepMap portal were used to identify HNSCC cell line models representative of *YAP1* copy number gain (OSC-20), *FAT1* LoF (OSC-19), and *YAP1-MAML2* gene fusion (SAS). YAP overexpression, YAP-MAML2 fusion protein expression, and *FAT1* loss were assessed using copy number assays, qPCR, immunofluorescence microscopy, and western blotting. Functional dependency on YAP-TEAD signalling was assessed by treatment with small-molecule TEAD inhibitors. Cell viability and proliferative capacity were evaluated using CyQUANT and colony formation assays.

OSC-20 cells displayed strong *YAP1* amplification, resulting in highly increased YAP protein levels. However, only a fraction of the overexpressed YAP protein was localised to the nucleus. Consequently, OSC-20 cells displayed a similar sensitivity to TEAD inhibition as OSC-19 cells with *FAT1* loss. SAS cells were not sensitive to TEAD inhibition, suggesting that the YAP-MAML2 fusion is able to overcome TEAD-dependency. Summarised, our findings indicate that HNSCC tumours with different molecular mechanisms of YAP activation may exhibit distinct vulnerabilities to TEAD inhibitors.

Keywords: YAP, TAZ, TEAD, HNSCC, Hippo pathway, targeted therapy

Immunomodulatory and Osteogenic Potential of Periodontal Fibroblast-Derived dECM

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Abstract

Background: Human periodontal fibroblasts possessing mesenchymal stem cell (MSC)-like characteristics have demonstrated regenerative and immunomodulatory potential. Decellularised extracellular matrix (dECM) derived from fibroblasts may actively modulate inflammatory signalling and tissue remodelling; yet its role in directing fibroblast–macrophage interactions remains largely unexplored. **Aim:** This study aimed to investigate the immunomodulatory and osteoregenerative capabilities of fibroblast-derived dECM using a fibroblast–macrophage indirect co-culture model combined with osteogenic assays. **Methods:** Human periodontal fibroblasts with MSC-like characteristics (Garna et al., 2020) were used to generate fibroblast-derived dECM. Fibroblasts cultured with dECM were indirectly co-cultured with PMA-differentiated THP-1 macrophage-like cells using a transwell system. Inflammatory and remodelling-associated cytokines, including IL-1, IL-6, and TGFB, were analysed by qPCR, while IL-10 protein expression was assessed by ELISA. Proteomic analysis was performed to characterise the dECM composition. Osteogenic potential was evaluated using Alizarin Red and Von Kossa staining. Statistical analysis was performed using ANOVA or Welch ANOVA with appropriate post hoc testing.

Results: Fibroblast-derived dECM significantly modulated inflammatory cytokine expression within fibroblast–macrophage co-culture systems. dECM reduced IL-1-associated inflammatory signalling while modulating IL-6 and TGFB expression in a dose-dependent manner, suggesting controlled remodelling-associated responses. ELISA analysis demonstrated increased IL-10 expression in dECM-treated groups, indicating potential anti-inflammatory effects. Proteomic analysis identified extracellular matrix-associated proteins involved in tissue remodelling and regenerative signalling. Osteogenic staining demonstrated enhanced mineralisation in dECM-treated groups, supporting the osteoregenerative potential of fibroblast-derived dECM.

Conclusion: Fibroblast-derived dECM exhibited potent immunomodulatory and osteoregenerative effects by modulating fibroblast–macrophage inflammatory crosstalk and enhancing osteogenic activity. These findings indicate that fibroblast-derived dECM holds strong promise as a biomaterial for periodontal and bone regeneration. **Keywords:** Decellularised extracellular matrix (dECM); periodontal fibroblasts; immunomodulation; fibroblast–macrophage crosstalk; osteogenic regeneration; tissue engineering

Development and Characterisation of a Novel Resin-Based Fissure Sealant Incorporating Inert Flake Glass Fillers

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Abstract

Objectives Flake glasses are inert fillers used in non-dental resin systems to enhance wear resistance. This study aimed to develop a light-cured fissure sealant incorporating inert flake glass fillers followed by characterisation of its chemical and physical properties.

Materials and Methods Four formulations were evaluated: an unfilled UDMA/TEGDMA base resin (control), the same resin with 30 wt% inert flake glass fillers, and two commercial sealants, Heliaseal F Plus (Heliaseal) and 3M Clinpro (Clinpro). Disc specimens (10mm x 1mm) were prepared in PTFE moulds between acetate strips and light-cured for 20 seconds. Degree of conversion (DC) was determined using Fourier Transform Infrared Spectroscopy (FTIR) with attenuated total reflectance (ATR), by comparing aliphatic-to-carbonyl peak ratios before and after curing (n=15). Vickers microhardness was measured at 200g load and 15 seconds dwell, with seven indentations per specimen (n=3), at baseline and after a 7-days demineralisation challenge in acetic acid (pH 4).

Results The unfilled base resin showed the highest DC (77.6%, SD±2.87), decreasing with 30 wt% flake glass incorporation (66.6%, SD±2.28). Commercial sealants showed lower DC Clinpro (63.6%, SD±4.23) and Heliaseal (55.5%, SD±3.79). Baseline hardness was highest for the 30 wt% flake glass formulation (21.0 HV, SD±0.87), exceeding the base resin (16.4 HV, SD±0.38), Heliaseal (17.4 HV, SD±0.92), and Clinpro (17.0 HV, SD±0.28). Following demineralisation, all groups showed reduced hardness; the 30 wt% formulation retained the highest values (14.8 HV, SD±0.74), compared to Clinpro (11.0 HV, SD±0.48), Heliaseal (9.8 HV, SD±0.47), and base resin (9.0 HV, SD±0.75).

Conclusions Incorporation of 30 wt% inert flake glass produced a fissure sealant with comparable DC and improved hardness relative to commercial materials, with superior hardness retention following demineralisation. Further investigation including retention testing, surface roughness, and fracture pattern analysis will be carried out.

Type 2 Diabetes Mellitus (T2DM) affects the tolerance of mesenchymal stem cells (MSCs) to fluctuating glucose levels and impairs wound healing ability

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Abstract

Objectives: Mesenchymal Stem Cells (MSCs) are autologous stem cells for bone regeneration and wound healing including alveolar bone regeneration. Assessing the effect of T2DM on their phenotype and wound healing capability are of high importance for future regenerative applications.

This study examined the impact of type 2 diabetes mellitus (T2DM) on the phenotype and proliferative capacity of native and minimally manipulated (MM) human MSCs isolated from bone marrow (BM) and knee joint (KJ) samples. In addition, to modelling the effect of fluctuating glucose levels on the expression and the migratory wound-healing capacity of MSCs

Methods: MSCs were isolated from BM and KJ samples from diabetic (D) and non-diabetic (ND) donors. Colony-forming unit-fibroblasts assay (CFU-F) was used to measure the MSCs renewability. Flow cytometry was used to evaluate stromal markers (CD90, CD271, CD44, CD146) and immune-related markers (CD45, CD14, CD86, CD206) in native and MM cells. The migratory wound-healing capacity of MM BM-MSCs under fluctuating glucose concentrations (1000–4500mg/L glucose every 2 hours), was assessed using a scratch assay, with wound closure quantified using Image J.

Results: Diabetic MSCs demonstrated decreased colony formation and smaller colony area compared to ND MSCs. Diabetic native KJ-MSCs had decreased CD271 and increased CD90 expression whereas diabetic BM-MSCs exhibited increased CD271 and decreased CD90 expression when compared to ND. Following MM culture, stromal markers were enriched while most immune-related markers decreased. However, diabetic BM-MSCs retained an inflammatory profile. In the scratch assay, all BM-MSCs groups showed similar rate of wound closure under normal glucose conditions. Under fluctuating glucose levels, wound closure ability was reduced, with diabetic BM-MSCs showing greater sensitivity to glucose fluctuation and lowered wound closure capacity compared to ND cells.

Conclusion: T2DM negatively impacts MSC function by reducing their proliferative capacity and altering phenotype, delaying wound healing, and reduced regeneration capabilities.

The use of biomarkers Defensins 2 and 3 for screening of oral cancer in a high-risk population in East London.

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Abstract

Objectives: With approximately 380,000 new cases diagnosed yearly and an overall five-year survival rate of around 50%, oral squamous cell carcinoma (OSCC) represents a major global health problem. In the United Kingdom, it is a particular concern in East London, where the incidence rate is 60% higher than the national average. Improving early detection and accurate diagnosis will significantly improve patient outcomes. The expression of human β -defensins (hBD) 2 and 3 has been reported to be dysregulated across various cancer types. In this study, we evaluated the feasibility of using a β -defensin index (BDI) to distinguish cancerous and precancerous lesions from non-cancerous lesions in clinically suspicious oral lesions.

Methods: Mucosal cytobrush samples were collected from 16 OSCC, 14 dysplasia, 43 non-dysplasia patients, and 12 healthy controls (HC). For each donor one sample was obtained from the lesion site and a corresponding control sample from the contralateral, lesion-free site. hBD2/3 levels were quantified by ELISA, and BDI scores calculated as the ratio of hBD3/hBD2 in the lesion site compared to hBD3/hBD2 in the normal site. BDI values were compared with histopathological results as the gold standard.

Results: Mean BDI values were compared among HC, non-dysplasia, and dysplasia + OSCC groups. Kruskal-Wallis analysis and Dunn's post hoc tests demonstrated significant differences between HC and dysplasia + OSCC groups ($p=0.0131$), and between non-dysplasia and dysplasia + OSCC groups ($p=0.0411$), with no significant difference between HC and non-dysplasia groups ($p=0.8242$). ROC analysis performed to evaluate the diagnostic performance of BDI, yielded area under the curve values of 0.6146 (HC vs non-dysplasia), 0.7440 (HC vs dysplasia), and 0.9295 (HC vs OSCC).

Conclusion: Our results show that the BDI effectively distinguished dysplasia and OSCC from non-dysplastic and healthy tissues, supporting BDI as a promising rapid, non-invasive, and cost-effective biomarker for early oral cancer screening in high-risk populations.

Enhanced pathogenicity of *Candida albicans* in heme-sources: a supporting role for *Porphyromonas gingivalis*?

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Abstract

Background: *Candida albicans* is increasingly associated with polymicrobial oral diseases, including periodontitis, which is often associated with the keystone periodontal pathogen, *Porphyromonas gingivalis*. Within the host, both microorganisms rely on heme-containing compounds as important iron sources. Although the pathogenic potential of *P. gingivalis* has been reported to increase during co-culture with *C. albicans* under conditions of heme competition, comparatively little is known about whether oral bacteria can conversely support the fungal acquisition of this essential nutrient, and what impact this may have on interkingdom interactions.

Methods: RNA-sequencing data from *C. albicans* dual-species biofilms with *P. gingivalis* or *Streptococcus gordonii* exhibited unique transcriptional responses with changes in heme acquisition pathways evident in the fungus when cultured with *P. gingivalis*. This motivated us to assess the effects of commercial hemin, *P. gingivalis*-derived μ -oxo bisheme and hemoglobin derivatives on *C. albicans* growth, morphology, virulence gene expression and pathogenicity using growth assays, microscopy, qPCR, spectrophotometry and a *Galleria mellonella* infection model. Haemophore complex formation of Csa2 with *P. gingivalis*-derived μ -oxo bisheme were performed under controlled *in vitro* conditions by using spectrophotometric measurements.

Results: Co-culture with *P. gingivalis*, but not *S. gordonii*, increased expression of *C. albicans* genes involved in heme acquisition and iron homeostasis, including *CSA1*, *CSA2*, *RBT5* and *PGA7*. Under iron-restricted conditions, commercial heme and μ -oxo bisheme derived from *P. gingivalis* promoted filamentation and increased expression of hypha-associated virulence genes, including *HWP1* and *ECE1*. These transcriptional and morphological changes translated to increased killing activity in *G. mellonella* larvae, supporting a functional increase in pathogenicity. Purified Csa2 hemophore bound μ -oxo bisheme suggesting that *P. gingivalis* may provide a source of heme to *C. albicans*.

Conclusion: Bacterially derived heme enhances virulence-associated traits in *C. albicans*, identifying a previously unrecognised mechanism by which *P. gingivalis* may influence fungal pathogenicity within polymicrobial oral communities.

The clinical and economic effectiveness of oral health interventions delivered by health visitors, community pharmacists and nurses- A systematic review.

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Abstract

Aim:

This systematic review aims to provide evidence on the clinical effectiveness, economic effectiveness, and best practices of non-dental health and social care professionals delivering oral healthcare interventions. Studies included were published between January 2000 and March 2026.

Methods:

This systematic review was grounded in the Joanna Briggs Institute, Cochrane, PRISMA-SR extension, and SWiM guidance for the conduct of systematic reviews. A search of electronic databases and grey literature, utilising forward and backwards searching, was conducted up to January 2026 using CINAHL COMPLETE, Web of Science, Cochrane, PubMed, Google Scholar, the Open Grey database, and a policy repository. The research proposal was registered with PROSPERO (CRD 420351119241). Duplicate title, abstract, and full-text screening was conducted by two reviewers.

Quality assessment was carried out using the ROBIS-1 toolkit for risk of bias and the revised JBI critical appraisal tool for randomised control trials. Key information was extracted and synthesised using the SWiM guidance.

Results: After full screening of 334 published articles, 62 studies were included in the final analysis, with 11 RCTs eligible for inclusion. The studies were of moderate to high quality and examined efficiency and improvements in maternal oral health, smoking cessation, and caries reduction.

Further results will be available later in 2026.

Conclusion: The studies show efficiency gains and improvements in oral health, such as reductions in gingival inflammation, bleeding scores, and dmft. Interventions were mainly provided by nurses in primary and community care settings, with tasks that could be transferred to other disciplines.

Keywords: Oral health; Oral health intervention; Oral health integration; Oral health promotion; Nurses; Midwifery; Community pharmacy; Community nursing; Health visitors; Effectiveness;

The systematic review is registered on Prospero (CRD 420351119241)

Effect of glass particle size and composition on the flexural strength of ion-leachable photocurable resin composites

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Abstract

Background: Bioactive glasses (BGs) in dental composites promote remineralisation and reduce the marginal leakage. However, it may compromise mechanical stability due to high solubility. Understanding this relationship is essential for developing durable bioactive dental materials.

Aim: To evaluate the effect of BG particle size and composition on the flexural strength (FS) of resin composites before and after immersion in deionised water for 7 and 28 days.

Methods: Specimens (30 × 2 × 2 mm, n=30) were prepared per ISO 4049. Materials were placed in custom acrylic moulds, covered with acetate and a glass slide, and loaded under 2 kg for 2 min to improve uniformity and minimise voids. Specimens were light-cured for 20 s (1197.16 ± 0.5 mW/cm²) at seven overlapping positions. The control contained 45 vol% resin and 55 vol% Sr-SiO₂ inert glass. Experimental groups substituted 10 vol% of the inert glass with either 45S5 BG (5, 10, and 16 µm) or low-sodium BG (15 µm). FS was measured at baseline, 7, and 28 days of immersion in deionised water using a universal testing machine and analysed via two-way ANOVA (p < 0.05).

Results: At baseline, FS increased with particle size; the 16 µm 45S5 and 15 µm low-sodium groups exceeded 80 MPa, while the 5 µm 45S5 group had significantly lower FS (~45 ± 3.93 MPa). By day 28, all 45S5 composites exhibited significant degradation, with the 5 µm group dropping to (~15 ± 2.15 MPa). Conversely, the low-sodium BG group maintained superior stability and a higher FS of FS at (~57.49 ± 3.93 MPa; p < 0.05).

Conclusions: Larger BG particles enhance initial strength, but 45S5-based composites degrade significantly due to high solubility. Low-sodium BG formulations are more effective at maintaining long-term mechanical integrity, suggesting resin composites should be formulated to optimise ion release without compromising long-term strength, particularly in load-bearing restorations.

Revealing the Toughening Mechanisms of Prismless Enamel: Machine Learning Resolves Functionally-Graded Crystallographic Ultra-structure in Extreme Biomineralisation Models

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Abstract

Objectives: The durability of tooth enamel originates from a complex functionally-graded architecture, which is poorly understood. Therefore, we aim to resolve the evolutionary limits of stress-resistance within thin enamel structures adapted to extreme bite forces using advanced synchrotron crystallography and discriminative-quantitative machine learning (ML) analytics.

Methods: Dinosaur (Tyrannosaur) tooth samples were sectioned into 200µm thick slices. Specimens were mapped using high resolution (20µm) synchrotron X-ray micro-diffraction (SµXRD) to visualise lateral variability in the structure of the hydroxyapatite (HaP) unit cell of the tooth enamel crystallites. To discriminate between the residual strain states of constituent HaP crystallites, 2D-diffraction patterns were polar transformed to a linear domain and combined with a custom neural-network to classify diffraction data by enamel structure. 2D deconvolution was used to extract lattice parameters, texture, and preferred orientation for individual crystallite orientation populations and validated against a clinically relevant comparative human tooth enamel reference. Data processing and analysis were conducted using Python software (PyFAI and FabIO packages).

Results: ML-SµXRD revealed previously unreported gradients in enamel crystallite concentration, orientation, texture and residual strains. At biting surfaces in the outer enamel, the HaP c-axis stores greater residual compressive strain. However, each distinct crystallite orientation population exhibits discrete residual strains and highly aligned textures, suggesting a structurally tuned distribution to optimize the mechanical deformation response. Toward the dentine–enamel-junction, lattice parameters form a continuum of elongation accompanied by a loss of crystallographic alignment, which are heterogeneous across the constituent crystallite populations ($p < 0.01$).

Conclusions: ML-SµXRD provides unprecedented insights into the functionally-graded architecture of highly resilient tooth enamel. This highlights how the patterning of residual strains and texture within enamel-crystallite populations likely tune stress-resistance to mitigate catastrophic structural failure. This quantitative and discriminative approach has translational capabilities to drive a deeper understanding of dental pathologies and inform the design of biomimetic restorative materials.

Title: Do adults value their oral health? Validation of the Oral Health Values Scale in a UK Cohort.

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Abstract

Background:

Oral health is largely a function of behaviours, which are strongly influenced by experiences, beliefs, and values. To measure these constructs empirically, psychometrically robust tools are essential. A 12-item Oral Health Values Scale (OHVS) was developed in the United States, measuring four domains: professional dental care, appearance and health, flossing, and retaining natural teeth. As values reflect individual, social, and cultural experiences of oral health, the validity of the OHVS for the United Kingdom (UK) population is unknown. This study aimed to validate the OHVS for a UK adult cohort.

Methods:

A prospective cross-sectional study was completed using an online questionnaire. NHS Ethical approval was obtained from Health and Social Care Research Ethics Committee B (23/NI/0140; 23/10/23). The questionnaire included participant demographics, the OHVS, the Dental Behaviours Scale (DBS), and dental care-related fear and anxiety items based on the Modified Dental Anxiety Scale. Participants were sampled from adults (aged 18-64) in North East England attending Newcastle Dental Hospital and urgent care dental clinics as well as via social media platforms. Anonymised data was collected, cleaned, and analysed. Statistical analyses included descriptive statistics, exploratory factor analysis and CFA, and multiple linear regression. External validity was measured by correlating OHVS and DBS scores.

Results:

504 English-speaking adults (mean age 39.4 years) were included. CFA showed that the Chi-squared value was 35.0 on 24 df, $p=0.07$, suggesting internal validity. The questions with uniqueness >0.75 were: 'it is important for me to keep my natural teeth', and 'I prefer to wait and see if it will go away'. There was a strong, statistically significant correlation between the total OHVS and DBS scores ($\rho=0.71$, $p<0.05$), supporting external validity.

The OHVS is a psychometrically robust tool to measure oral health values amongst UK adults. The scale could be used to inform research, policy, and practice.

Cross-Dataset Reproducibility of Deep Learning Models for Tooth Segmentation on Panoramic Radiographs

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Abstract

Objectives: Deep learning methods for segmenting teeth and supporting structures from 2D and 3D dental radiographs are rapidly advancing, achieving high accuracy. However, clinical deployment requires robust performance across centers, populations, and scanner types. Most studies focus on single-center datasets, limiting insight into real-world robustness. This study evaluated the reproducibility and cross-dataset performance of U-Net–based dental segmentation across multiple 2D panoramic radiograph datasets.

Results: All models showed strong segmentation performance, but results varied with dataset characteristics, domain shift, and training strategy. On the internal Tufts dataset, performance ranged from IoU 0.818–0.865 and DSC 0.884–0.927, with UNet++ achieving the highest scores, while DentalUNet with a ResNet backbone offered a better efficiency tradeoff. On the first external validation dataset (Mendeley) without augmentation, performance declined (IoU by 3–4%, precision by 5–7%), highlighting domain shift effects. Applying augmentation improved stability and generalizability, especially for DentalUNet. On the second validation (Jazan) dataset, performance improved across all models, exceeding internal results, with DentalUNet + augmentation achieving the best scores (IoU 0.876, DSC 0.934).

Conclusion: This study demonstrates that tooth segmentation algorithms produce strong, comparable performance within individual datasets. However, performance varies significantly across datasets and is influenced by differences in dataset characteristics, quality, annotation standards, and data augmentation strategies. Limited cross-dataset generalizability remains a key barrier to the clinical translation of AI-based tooth segmentation in dentistry. Accordingly, the focus should shift from pursuing architectural novelty toward developing widely available, high-quality, well-annotated datasets from diverse sources, alongside models capable of generalizing across datasets. Such datasets and models can support more robust training, improve generalizability, and facilitate adaptation to different imaging environments - critical factors for accelerating the clinical translation of AI-based segmentation systems.

Development of a novel hydraulic cement sealer for root canal treatment.

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Abstract

Aim: Hydraulic cement sealers are clinically available as hand-mixed formulations, where water is added during mixing or as single-syringe formulations, where moisture is obtained from the clinical environment. This study investigated a novel double-barrel syringe system for automated water-cement mixing, comparing its performance against traditional hand-mixed formulations and single-syringe systems with the expectation of delivering enhanced chemical activity at both early and extended timepoints, alongside improved physicochemical and antimicrobial properties. **Methods:** Design of experiment (DoE) method was used to formulate the sealers using a full factorial design to achieve optimised desirable properties. The physical properties were assessed for all tested formulations. Microstructural and compositional analyses were performed using scanning electron microscopy, energy-dispersive spectroscopy and X-ray diffraction. Ion release and pH were quantified using Inductively Coupled Plasma pH measurement. Antimicrobial efficacy was assessed against a clinically relevant multispecies biofilm (*Enterococcus faecalis*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Streptococcus oralis*) at 0, 7, 28 and 90 days (n=3) in conjunction with confocal microscopy and SEM. Statistical analysis employed ANOVA with Tukey post-hoc and Kruskal-Wallis testing where appropriate. **Results:** DOE-guided formulation development yielded consistent, reproducible outcomes. The novel sealer demonstrated superior hydration characteristics and more consistent setting behaviour with favourable rheological properties compared to controls ($p < 0.05$). All the tested sealers contained zirconium, calcium and silicon. The novel formulation demonstrated sustained calcium hydroxide peaks throughout the 90-day observation period. All sealers showed microstructural porosity at extended timepoints. The novel sealer exhibited significantly enhanced antimicrobial activity against the multispecies biofilm ($p < 0.05$), particularly in the early setting phase. Ion release profiles correlated with sustained alkalinity. **Conclusion:** The novel sealer exhibited superior hydration with automated water delivery, which is clinically beneficial, with prolonged alkaline release and enhanced antimicrobial potential compared to commercially available formulations. These findings suggest promising clinical applications and warrant further *in vivo* evaluation.

3D Occlusion Quantification of Dual Action Formulation with SBF-SEM and Comparison with HC

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Abstract

Background

Serial Block Face Scanning Electron Microscopy (SBF-SEM) and Hydraulic Conductance (HC) are established occlusion efficacy testing methods. However, their outcome measures originate from different but complimentary efficacy origins.

Objectives

To utilise SBF-SEM to compare and contrast the origins of the efficacy testing outcomes from formulation matched dentine samples tested via standard HC and standard brushed SBF-SEM treatment protocols.

Methods

Human dentine samples for both HC and SBF-SEM were treated with pastes containing two active ingredients Novamin and SnF₂, with varying wt% Novamin, Novamin and SnF₂ only control pastes, as well as a no active ingredient control. For HC, samples were treated with toothpaste slurry over the surface followed by a 5-min flow reduction measurement, and the process is repeated for a total of 4 times. For SBF-SEM, samples were brushed twice a day for 2 days and were extracted for timepoints of 24h and 48h, followed by imaging using SBF-SEM (n = 2 per paste per method). A tubule inclusion criterion based on tubule diameter was applied to ensure quantification (percentage of occluded tubules and occlusion depth) was performed on tubule diameter matched samples.

Results and Discussion

SBF-SEM on brushed samples showed overall unpronounced dosage-based effect from different concentrations and exhibited similar occlusion levels throughout, whereas HC flow results showed different and superior occlusivity. SBF-SEM imaging revealed the formation of a thin occlusive surface layer on HC samples, due to the lack of mechanical brushing in the tests.

Hence, spaced-out brushing events promoted active-ingredient induced occlusion deeper in the tubules, whereas HC flow results were influenced by the rapid surface precipitation of toothpaste slurry. Additionally, SBF-SEM brushing quantification was influenced by sample variability due to the lack of sample-specific controls. In contrast, measured flow reduction in HC is a function of the individual samples' baseline flows, mitigating sample-based influence.

Evidence on the effectiveness of interventions to assess and promote oral health among children and young people in hospital with complex medical conditions: A systematic review.

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Abstract

Background

Children admitted to hospital with complex medical conditions are at increased risk of poor oral health due to illness, treatment-related side effects, and limited access to routine oral hygiene.

Objectives

To systematically review and synthesise the evidence on the effectiveness of oral health assessment and promotion interventions for children and young people hospitalised with complex medical conditions and examine associated health and social care outcomes.

Methods

Searches were undertaken in MEDLINE, Web of Science, and CINAHL for studies published between 2005 and 2025. Eligible studies included qualitative, quantitative, and mixed-methods research evaluating oral health assessment, promotion, or preventive interventions delivered in hospital settings to paediatric inpatients with complex medical conditions.

Results

Eighteen studies were included for data extraction and narrative synthesis. The studies evaluated oral health education or promotion programmes, structured oral care protocols, chlorhexidine-based interventions, adjunctive oral care approaches, and integrated multidisciplinary oral care models.

Study designs included six randomised controlled trials, four non-randomised controlled studies, five quasi-experimental studies, one quality-improvement study, and two qualitative studies.

Oral mucositis was the most frequently reported outcome (12 studies), followed by oral hygiene measures (8 studies) and gingival health (6 studies). Systemic health outcomes were less commonly assessed.

Evidence consistently demonstrated improvements in oral health outcomes, particularly reductions in dental plaque, gingival inflammation, and oral mucositis. Several studies also reported broader health benefits in some contexts, including reductions in bloodstream infections, ventilator-associated infections, and treatment interruptions.

Conclusions

Oral health assessment and promotion interventions and integrated oral care protocols in hospitalised children with complex medical conditions are associated with meaningful improvements in oral health and, in some cases, systemic health outcomes. Future evaluations should use random clinical trial models, standardised outcomes, and economic evaluation analyses.

Beyond House-of-Cards: A Novel Barium Cabbage-Head Microstructure in Machinable Dental Glass-Ceramics

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Abstract

Background: Dental CAD/CAM glass-ceramic restorations require materials combining efficient machinability with suitable mechanical performance and processing characteristics for chairside fabrication. Currently available CAD/CAM blocks exhibit favourable strength and aesthetics, but their extremely high hardness increases machining difficulty and contribute to tool/enamel wear. Barium fluormica is a highly machinable glass-ceramic that can present an alternative solution to this problem due to their unique '*House-of-Cards*' (HOC) microstructure. Recent work on barium-based fluormica glass-ceramics has identified a novel '*Cabbage-Head*' (CH) microstructure characterised by unusually 'curved' mica crystals and a morphology distinct from conventional HOC. However, the crystallisation conditions governing CH formation remain poorly understood. In particular, the role of barium in directing phase development and microstructural evolution has not yet been established. **Aim:** Investigating the influence of barium content on crystallisation behaviour and microstructural development in barium-based fluormica glass-ceramics for potential dental CAD/CAM applications. **Materials and methods:** Glass compositions with systematically varied BaO content were synthesised by melt-quenching and subjected to controlled heat treatment. Differential scanning calorimetry, X-ray diffraction, scanning electron microscopy, and magic-angle spinning nuclear magnetic resonance (MAS-NMR) spectroscopy were used to evaluate thermal behaviour, phase development, and structural evolution. **Results:** Demonstrated that barium content systematically influenced crystallisation behaviour and mica microstructure. Although all compositions formed crystalline mica phases, clear differences were observed in phase evolution and microstructural morphology with changing BaO concentration. The CH morphology emerged only within a narrow compositional and heat-treatment window, indicating a strong dependence on specific processing conditions. MAS-NMR analysis provided complementary structural insight that supported interpretation of phase development. **Conclusion:** These findings provide new insight into how barium influences crystallisation and mica glass ceramic morphology. Improved control of the CH microstructure in barium mica glass ceramic supports the future development of machinable dental glass-ceramic CAD/CAM blocks with more efficient milling behaviour and processing characteristics.

Metabolic Reprogramming in Gingivitis, Periodontitis, and Metformin Response

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Abstract

OBJECTIVES

Periodontal disease encompasses a spectrum from reversible gingivitis to destructive periodontitis, yet the metabolic mechanisms driving disease initiation and progression remain poorly defined. This study aimed to: (i) characterise gingival metabolic reprogramming during gingivitis and periodontitis induction; (ii) elucidate the metabolic effects of metformin in healthy gingiva; and (iii) determine how metformin modulates local and systemic metabolism during periodontal disease progression.

MATERIAL AND METHODS

Two in vivo murine models were employed to independently induce gingivitis and periodontitis. Thirty-six mice were allocated into six experimental groups, including healthy controls, gingivitis, periodontitis, and corresponding metformin-treated groups, with appropriate controls for all conditions. Gingival tissues and systemic blood samples were collected at defined time points. Untargeted LC-MS/MS metabolomics was performed on both local and systemic samples. Multivariate analysis and pathway enrichment were applied to identify disease- and treatment-associated metabolic alterations.

RESULTS

Gingivitis induction produced early metabolic alterations characterised by increased glycolytic activity and partial disruption of TCA cycle balance, representing a transitional metabolic state. Progression to periodontitis resulted in a pronounced “Warburg-like” phenotype, marked by elevated glycolysis, succinate accumulation, and sustained metabolic support for inflammation at both local and systemic levels. Metformin treatment did not simply normalise oxidative phosphorylation. Instead, it induced a distinct, metabolically suppressed state, downregulating glycolytic and TCA cycle pathways in healthy, gingivitis, and periodontitis models. This effect was observed in gingival tissues and mirrored systemically, suggesting coordinated host metabolic reprogramming.

CONCLUSION

These findings redefine gingivitis and periodontitis as metabolically driven inflammatory diseases. Metformin exerts therapeutic effects through active metabolic reprogramming that suppresses the Warburg-like phenotype required for disease progression. Targeting host metabolism may offer a novel preventative and therapeutic strategy to halt periodontal disease before irreversible tissue destruction occurs.

How cells talk, the influence of cancer stem cell - stromal interactions on tumour progression in oral squamous cell carcinoma

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Abstract

Oral squamous cell carcinoma (OSCC) accounts for approximately 50% of all head and neck cancers. Mainstay treatment includes surgery with or without radiotherapy, chemotherapy and immunotherapy. The five-year survival rate remains low at 56.1%.

Cancer stem cells (CSCs) are an important tumour subpopulation with important metastatic and therapeutic resistance abilities. These cells are plastic with the ability to switch from an epithelial, stationary and rapidly dividing phenotype to mesenchymal, motile and slowly dividing. However, the interplay between CSCs and the tumour microenvironment is poorly understood and potentially a viable therapeutic target.

To investigate this, a cohort of 49 human OSCC hematoxylin and eosin specimens, stratified on metastatic outcome, were independently scored by a trainee and Consultant Pathologist. Results identified an interrelated triad of poor prognostic features; a poor immune infiltrate, desmoplasia and discohesive, multidirectional tumour invasion. However, results lacked a resolution in regards to CSC-stromal relationships.

14 heterogenous cases were subsequently selected for multiplex immunofluorescence (CellIDIVE). Specimens were stained with 21 antibodies, including CSC's, stromal cells and extracellular matrix components.

Preliminary results show increased vimentin and PDPN colocalization associated with poor prognosis (delta Z score=-348.8, $p<0.05^*$). Cancer associated fibroblasts (CAFs) were significantly increased at the invasive edge in poor prognosis tumours ($p<0.05^*$) whereas in good prognosis tumours this enrichment consisted of regulatory T cells ($p<0.05^*$), T helper cells ($p<0.01^{**}$), lymphatic endothelial cells ($p<0.01^{**}$) and M1 macrophages ($p<0.05^*$). Neighbourhood analysis identified increased co-localisation of epithelial restricted and hypoxic cells with CAF, T cell, macrophage and vascular endothelial cell populations ($z \geq 50$, $p<0.05^*$) in good prognosis tumours. Poor prognosis tumours instead featuring increased mesenchymal tumour-tumour enrichment ($z \leq 50$, $p<0.05^*$) and stromal-stromal enrichment ($z \leq 50$, $p<0.05^*$).

7 cases were further analysed using 6000-plex Cosmx spatial transcriptomics with aim to identify potential therapeutic targets utilising ligand-receptor, tumour-stromal interaction, analysis.

Engaging in oral health research - the opportunities and the sacrifices: a qualitative study

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Abstract

Background:

The clinical academic workforce in dentistry has reduced dramatically in the UK, while demands for high-quality research to address priority areas remain high. The NIHR-supported Oral Health Research Incubator was launched in 2025 and aims to build capacity and develop research careers in oral health research. This qualitative study aimed to explore barriers and enablers to engagement in oral health research.

Methods:

Guided by the Theoretical Domains Framework (TDF) semi-structured interviews were conducted with a purposive sample of oral health professionals, dental academics, methodologists, policy makers and funders of research. The interviews were transcribed verbatim and analysed using a framework approach

Results:

To date, 27 participants have been recruited. Interim analysis suggests while engaging in research is viewed positively both personally and professionally it brings with it opportunity costs often requiring sacrifices of time (due to the additional workload often undertaken outside of working hours), finances and career progression. Engagement in research was motivated by a desire to be part of advances in population-wide patient care and brought benefits such as variety and opportunities for travel. Sacrifices were seen as a worthwhile investment for those who have developed research careers, but there was awareness that this might not be accessible to all for reasons including work/life balance and home commitments. Support and mentorship from experienced colleagues appears vital to raise awareness, inspire involvement and aid career progression, especially for those based in primary care and dental care professionals.

Discussion:

The interim findings highlight the varying experiences of engagement with oral health research. The next stage will involve further analysis to identify barriers and enablers and will employ behaviour change theories to suggest appropriate recommendations to support future engagement.

Monitoring Progression of *in-vitro* Demineralisation of Hydroxyapatite Pellets using Real-Time Optical Coherence Tomography (RTOCT)

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Abstract

Background: OCT is a non-invasive imaging modality that is gradually being introduced into both clinical dental practice and research. Clinically, OCT offers many benefits, including being radiation-free, pain-free, and rapid. Although its introduction in ophthalmology and other medical fields is extensive, its development in clinical dentistry has been slower, partly because interpreting OCT images is not as straightforward as interpreting X-ray images.

As a research tool, OCT also has many advantages: the equipment is less expensive and complex than other 3D imaging techniques, e.g., microtomography, and there are many opportunities for its development in dental research. The aim was to construct a system that enables the use of OCT at an imaging resolution of 2.2µm to monitor the progression of artificial lesion development in permeable hydroxyapatite (HAp) discs.

Materials and Methods: A Perspex flow cell was constructed through which acetic acid at pH=4.0 could be circulated via a pump from a reservoir. A HAp disc was located within the cell and covered with a microscope coverslip, as acid was pumped through. A Thorlabs Ganymede OCT (Cambridge) system was used for data acquisition and to acquire, reconstruct, and display the OCT data. The OCT parameters were: A-Scan Rate: 20kHz, A-Scan Averaging: 5, Field of View: 8.56(X) x 8.30(Y) x 2.26(Z) mm: Pixel Size: 35.09(X) x 35.01(Y) x 2.21(Z) µm. OCT scans were taken every 60 mins for 72h. An in-house algorithm was used to calculate the mineral loss as a function of time.

Results: The real-time OCT imaging demonstrated a linear relationship with time mineral loss in HAp discs exposed to acid at pH=4.0 over 72h at a resolution of 2.2µm.

Conclusion: Real-time OCT can be used to quantitatively monitor mineral loss in artificial *in-vitro* caries systems, and to investigate the effect of surface treatments.

Adaptable in vitro oral mucosa models - scRNA-seq-based characterisation, modifiable mechanical scaffold properties, biofilm challenge and high-throughput screening.

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Abstract

Three-dimensional (3D) organotypic cultures of oral mucosa (OM) involve differentiating layers of epithelial cells, growing on top of fibroblast-containing matrix, most commonly collagen hydrogel, maintained at air-liquid interface. They recapitulate key structural features of squamous epithelium and underlying lamina propria and provide controlled, ethical, and reproducible research platforms. However, rigorous validation is needed to confirm their ability to faithfully represent *in vivo* tissue composition. In addition, high-throughput screening systems are required to ascertain their translational relevance, while scaffold modifications would allow to control mechanical properties and epithelium-ECM interactions. Finally, introduction of bacterial component would expand the translational applications to antimicrobial testing.

Here, we characterised a head and neck squamous cell carcinoma (HNSCC) OM model using single-cell RNA sequencing and immunostaining to assess maturation, cellular heterogeneity, functionality, and inter- and intra-tissue interactions within epithelial and stromal compartments. The epithelial layer of the model differentiated into populations closely resembling the tissue of tumour origin, including dividing and precursor cells, heterogeneous basal layer, suprabasal cells, and metabolically specialised populations. The collagen-rich stroma contained functionally diverse fibroblasts reflecting the heterogeneity of cancer-associated fibroblasts *in vivo*, including dividing, matrix-producing, immune-responsive, and tumour-like populations. Importantly, extensive epithelial–stromal communication networks developed, essential for cancer epithelium maintenance and tumour microenvironment regulation, while highlighting potential therapeutic targets.

Replacing collagen scaffold with collagen-GelMA (gelatin methacryloyl) hybrid hydrogels enabled control of matrix stiffness and further model development towards semi-automated, high-throughput 24-well based system suitable for drug screening. In addition, the collagen-GelMA modification allowed for inclusion of titanium implants to model peri-implantitis by introducing *S. oralis*/*S. sanguinis* biofilm challenge and assessing antimicrobial properties of copper-containing titanium implants.

Overall, this organotypic oral mucosa model exhibits high functional fidelity and adaptability to various clinical scenarios, therefore bringing confidence in pre-clinical non-animal testing.

Surface characterisation of acid-etched hydroxyapatite and its preliminary immunomodulatory activity in PgLPS-stimulated macrophages

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Abstract

Synthetic hydroxyapatite (HA) is a calcium phosphate biomaterial used in regenerative and implant dentistry, due to its physicochemical properties and promising interactions with the host immune system. However, an important gap remains regarding how macrophage-material interactions influence inflammatory responses to HA under bacterial stimulation. This study aimed to characterise the surface properties of acid-etched synthetic HA and generate preliminary evidence of its immunomodulatory activity in THP-1-derived M1-like macrophages stimulated with *Porphyromonas gingivalis* lipopolysaccharide (PgLPS) *in vitro*.

Two *in vitro* models were used: (1) a direct contact model representing HA interaction with a pre-exposed inflammatory environment and (2) a cell-seeded model, representing early macrophage recruitment to a newly encountered implant. Surface characterisation was performed by SEM, XRD and FTIR. TNF- α secretion was quantified using ELISA as a preliminary functional readout of M1 activation.

Characterisation data confirmed the structural and chemical integrity of HA across all experimental conditions. Preliminary functional data indicated a reduction in TNF- α secretion in PgLPS-stimulated M1 across both models, with 46.8% reduction in the direct contact model and 63.7% in the cell-seeded model, alongside reduced cellular clustering observed by light microscopy. SEM revealed a heterogeneous topography on the acid-etched disc surface, with biological material deposition under stimulated conditions. XRD confirmed preservation of characteristic HA crystalline structure, indicating observed effects are attributable to cell-material interaction rather than material degradation. FTIR confirmed retention of phosphate bands, with additional C-H and O-H/N-H bands in PgLPS-stimulated groups, consistent with protein or lipid adsorption via electrostatic interactions at calcium sites.

Overall, rigorous surface characterisation confirmed the physicochemical integrity of acid-etched HA across experimental conditions. Preliminary functional data suggest HA may attenuate macrophage-driven inflammation via altered integrin signalling. The signal observed across both contact configurations warrants further investigation and, if replicated, would support its role in modulating early peri-implant inflammatory responses.

Antibacterial and Antibiofilm Performance of Boron Nitride Nanosheet reinforced Resin-based Composite

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Abstract

Objective

This study aimed to evaluate the antibacterial and antibiofilm performance of hexagonal boron nitride nanosheet (BNNS)-reinforced resin-based composite (RBC) against oral cariogenic bacterium *Streptococcus mutans* (*S. mutans*).

Methods

A Bis-GMA/TEGDMA-based flowable composite with 40 wt% barium glass fillers served as the control. BNNS (0.25–1.0 wt%) were incorporated via ultrasonication, SpeedMixing and vacuum degassing. Disc-shaped specimens were light-cured and sterilised. Minimum inhibition concentration (MIC) was determined by broth microdilution. Inhibition zones were assessed via agar diffusion. Antibacterial and antibiofilm performance was investigated using CFU counts, resazurin and MTT assays, crystal violet staining and live/dead staining. Biofilm morphology was characterised by SEM. Statistical analysis was performed using one-way ANOVA with Tukey's post-hoc test ($\alpha = 0.05$).

Results

The MIC of BNNS was 0.032 mg/mL, with no minimum bactericidal concentration (MBC) up to 1.024 mg/mL. No inhibitory zones were observed. Increasing BNNS content significantly reduced *S. mutans* CFU counts, metabolic activity, and biofilm biomass at 24 h and 72 h, with effects more pronounced on biofilm-associated bacteria than planktonic cells. At 1.0 wt%, antibacterial rates reached 63.3% (24 h) and 67.0% (72 h). Metabolic activity decreased by ~50% (24 h) and 35–43% (72 h), while biofilm biomass reduced by 41.7% and 50.1%, respectively. CLSM showed increased bacterial death with higher BNNS loading. SEM revealed membrane deformation and collapse of bacteria in contact with BNNS.

Significance

Low loadings of BNNS (≤ 1.0 wt%) significantly enhance the antibacterial and antibiofilm properties of RBCs against *S. mutans*. BNNS therefore represent a promising, aesthetically compatible nanofiller for tooth-coloured restorative materials to reduce secondary caries.

Keywords

boron nitride nanosheets, resin-based composite, *Streptococcus mutans*, biofilms, antibacterial activity

The effects of saline mouth rinse on the oral and systemic health in healthy individuals

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Abstract

Background: There is some evidence that mouthwash use alters the oral and systemic health, including blood pressure. UK guidelines currently advise the use of ½ - 1 teaspoon of salt in a cup of water (saline) mouth rinse following tooth extractions, but more evidence is needed to support this practice and define its effects on oral and systemic health.

Aim: To conduct primary care based clinical trial, to determine whether oral and systemic health are altered by saline mouth rinse in healthy people.

Methods: In this double-blinded, randomised controlled trial, healthy adults ≥18 years without periodontal disease rinsed with 10ml of 2.5% of saline (A; n=25) or distilled water (B; n=25) for 30 seconds, twice daily, for 7 days. Systolic (SBP) and diastolic blood pressure (DBP), blood glucose, plus O'Leary plaque and gingival bleeding scores were recorded before and after the intervention.

Results: Bleeding scores in Group A showed a statistically significant reduction after 7 days of mouth rinse (6.8% to 3.5%; P=0.005). Conversely, Group B demonstrated no significant change in bleeding scores after 7 days (7.0% to 7.0%, P=1.000). Plaque scores exhibited no significant changes.

There were no significant changes in SBP after 7 days in Group A (114.6 to 113.6 mmHg; P=0.662), or Group B (119.7 to 122.9 mmHg; P=0.127). DBP decreased slightly in Group A (74.5 to 71.9 mmHg; p=0.07), but not in Group B (76.9 to 78.7 mmHg; P=0.133). Blood glucose was 5.9 and 5.2 mmol/L (P=0.380) between visits, whereas Group B were 5.42 and 5.38 mmol/L (P=0.620) respectively.

Discussion: Overall, the results suggest that 7 days use of saline mouth rinse in healthy people can reduce gingival bleeding, alongside possible reduction of diastolic blood pressure. Further studies are needed with complete datasets that investigate oral disease; where saline mouth rinses have more clinical use.

A randomised controlled trial determining maintenance of periodontal health following non-surgical periodontal treatment plus twice daily 67% sodium bicarbonate toothpaste

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Abstract

Background: Relapse of periodontal disease between maintenance visits remains common despite oral hygiene instruction (OHI) and professional mechanical plaque removal (PMPR). Sodium bicarbonate toothpastes have demonstrated reductions in bleeding and plaque in gingivitis studies, but their role in maintenance during treatment of periodontal disease has not been fully explored. Scalable home-care interventions are increasingly important, considering current challenges accessing oral healthcare in the UK.

Aim: To investigate the clinical effectiveness of twice-daily brushing with a 67% sodium bicarbonate toothpaste for 6-months alongside OHI and 3-monthly PMPR.

Methods: In this double-blinded, randomised controlled trial, adults ≥ 18 years with periodontitis stages I-III (≥ 16 teeth) received PMPR via a dental hygienist in primary care, plus oral hygiene instruction over 3 appointments (Baseline, 3-months and 6-months). Participants were either allocated 67% sodium bicarbonate toothpaste (test) or a standard fluoride toothpaste (control). Participants brushed twice daily for 6-months. Clinical outcomes included plaque indices, gingival bleeding, PPD and CAL. Linear mixed-effects models adjusted for age, sex, smoking status, denture use, and additional weeks of toothpaste use were used to analyse longitudinal changes.

Results: PMPR was successful in reducing gingival bleeding ($p < 0.001$), plaque index ($p < 0.001$), PPD ($p < 0.009$) and CAL ($p < 0.001$) ($n = 68$). Compared with control, the test group showed significant reductions in gingival bleeding over 6 months (-7.4% vs -6.5% ; $\text{time} \times \text{group } p = 0.035$). No significant difference was seen in the groups perceived use of the toothpaste or oral hygiene instruction at home.

Discussion: Findings suggest that sodium bicarbonate toothpaste enhances periodontal maintenance, and its use may offer an adjunctive choice for patients to enhance the effectiveness of both professional and at home management of oral hygiene.

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Biomimetic Zwitterionic Polymer Coating for Antibacterial Enhancement of 3D-Printed and Thermoformed Orthodontic Aligners

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Abstract

Background:

Clear aligners are widely used in orthodontic treatment; however, their surface characteristics may promote bacterial adhesion and biofilm formation, increasing the risk of oral diseases and enamel demineralisation. Surface modification has emerged as a promising strategy to improve the antimicrobial behaviour of dental biomaterials. This study evaluated the effect of a biomimetic zwitterionic polymer coating using 2-methacryloyloxyethyl phosphorylcholine (MPC) on the antibacterial, biological, and physicochemical properties of thermoformed and 3D-printed aligners.

Methods:

Thermoformed and 3D-printed aligner specimens underwent surface activation prior to coating to enhance MPC bonding and coating stability. Following surface activation, specimens were coated with MPC, a biomimetic zwitterionic polymer that mimics phospholipid components of cell membranes. Antibacterial activity against *Streptococcus mutans* and *Staphylococcus aureus* was evaluated using colony-forming unit (CFU) quantification and biofilm formation analysis. Biocompatibility was assessed using fibroblast cell viability assays. Surface wettability was analysed by contact angle measurements before and after immersion in artificial saliva for 7 days to evaluate coating durability. Water sorption and solubility tests were conducted according to ISO standards. Statistical significance was set at $p < 0.05$.

Results:

MPC-coated specimens demonstrated significantly reduced bacterial adhesion, CFU counts, and biofilm formation for both *S. mutans* and *S. aureus* compared with uncoated controls. Cell viability analysis confirmed favourable biocompatibility of the coated materials. Contact angle measurements revealed significantly lower values in coated groups before and after artificial saliva immersion, indicating enhanced hydrophilicity and coating stability. Water sorption and solubility values remained within clinically acceptable ranges for both thermoformed and 3D-printed aligners.

Conclusions:

Surface-activated MPC coating enhanced the antibacterial properties and hydrophilicity of thermoformed and 3D-printed aligners without compromising biocompatibility or physicochemical stability. As a biomimetic zwitterionic polymer, MPC may represent a promising surface modification strategy for reducing biofilm accumulation and improving the clinical performance of clear aligner systems.

Targeting Multispecies Oral Biofilms with Chlorhexidine–Polyol Combinations in a 3-D Gingival Model

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Abstract

Antimicrobial resistance (AMR) is a major global health challenge, with biofilm formation representing one of the most difficult microbial survival strategies to overcome. Within biofilms, microorganisms are protected by an extracellular polymeric substance (EPS) matrix that restricts antimicrobial penetration, promotes persistence, and enhances tolerance to treatment. In the oral cavity, polymicrobial biofilms are central to the development of dental caries and periodontal disease, both of which affect billions of people worldwide. However, most biofilm studies focus on single-species models, which do not fully reflect the complexity of clinically relevant oral microbial communities.

This project aims to develop and evaluate novel antimicrobial combinations against multispecies oral biofilms formed by *Streptococcus mutans*, *Streptococcus oralis*, *Streptococcus sanguinis*, and *Candida albicans*. *S. mutans* is a key cariogenic bacterium, while *C. albicans* is an opportunistic fungal pathogen frequently detected in oral biofilms. Their interaction can enhance biofilm biomass, structural complexity, and microbial persistence. Early colonizing streptococci, including *S. oralis* and *S. sanguinis*, contribute to initial attachment and biofilm maturation, making them essential components of a representative oral biofilm model.

Multispecies biofilms will be established and optimized in vitro, followed by investigation of biofilm attachment, survival, and host–pathogen interactions using a three-dimensional gingival model based on a buoyant epithelial culture device (BECD). This model provides a physiologically relevant, tissue-like platform for evaluating biofilm behavior and antimicrobial efficacy. Chlorhexidine will be assessed alone and in combination with selected polyols, including xylitol, maltitol, and sorbitol, for their ability to disrupt biofilm formation, reduce microbial adhesion, and enhance antimicrobial activity.

By targeting multiple biofilm-associated mechanisms within a clinically relevant model, this study will provide new insight into bacterial–fungal oral biofilm interactions and support the development of improved antimicrobial strategies for managing biofilm-associated oral diseases.

Saudi Electronic Caries Assessment Tool (SECAT) Development: Mixed Methods Feasibility Study

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Abstract

Background: Dental caries is a significant public health challenge globally, particularly acute in Saudi Arabia's remote areas with limited healthcare access. Traditional paper-based methods for recording epidemiological data have limitations in data collection, storage, and sharing, highlighting the need for mobile solutions to enhance dental surveillance in resource-limited settings. **Objective:** To develop and evaluate the Saudi Electronic Caries Assessment Tool (SECAT), a mobile application designed for collecting dental caries data in remote locations, following a user-centered design approach. **Methods:** This mixed-methods feasibility study was conducted in three stages: (1) requirement gathering through semi-structured interviews with 12 dental professionals to explore experiences and needs; (2) development of the SECAT application using Flutter frontend and Supabase backend; and (3) evaluation through usability testing with 18 clinicians and heuristic study with five domain experts. **Results:** The usability study revealed an 82% overall satisfaction rate among clinicians, with 78% strongly endorsing the application's user-friendly features. Expert evaluation highlighted the application's utility for remote areas and offline functionality. Key improvements implemented based on feedback included an automated tooth recognition system, enhanced visualization protocol, and integration of clinical metrics. Primary limitations identified included the need for improved color contrast and individual-level calculations of dental indices. **Conclusions:** The SECAT application demonstrated high satisfaction and acceptability among dental health providers for collecting examination data in remote locations. The preliminary evaluation identified both limitations and positive aspects, particularly regarding utility in areas with limited internet connectivity. The SECAT mobile application could be a valuable aid for caries assessment in remote places and also in school and community-based dental health programs.

Evidence-Based Clinical Oral Health Guideline Protocol for Infants in Saudi Arabia: A Consensus Framework for Dental Hygiene Clinic Practice

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Abstract

Background:

Early childhood caries (ECC) and life-course dental caries represent a major public health challenge in Saudi Arabia, with prevalence exceeding 75% in primary dentition and persisting into adulthood. This burden is reinforced by a culture of symptom-driven dental attendance, where over 82% of individuals seek care only when in pain. Despite universal access to free dental services, there is no standardized, culturally adapted infant oral health guideline within Saudi Ministry of Health (MOH) dental hygiene clinics.

Objective:

To develop an evidence-based clinical oral health guideline protocol for infants (0–12 months) within Saudi MOH clinics, targeting both ECC prevention and long-term caries reduction, and to promote early preventive dental visits to improve attendance behaviors across generations.

Methods:

A structured evidence synthesis was conducted using PubMed, MEDLINE, Scopus, Cochrane, and Web of Science. Guideline quality was appraised using AGREE II, and evidence strength was graded using a GRADE-informed four-level scale (Strong, Moderate, Limited, Expert Consensus). Recommendations were supported by established guidelines from AAPD, IAPD, SIGN, and NICE.

Results:

Ten graded clinical recommendations were developed, addressing first dental visit timing, clinical examination, caries risk assessment, fluoride use, dietary counseling, oral hygiene instruction, recall intervals, referral criteria, and long-term documentation. The protocol includes Saudi-specific adaptations incorporating local epidemiology, cultural risk factors, and strategies to reduce symptom-driven care-seeking behavior.

Conclusion:

This is the first Saudi-adapted, evidence-based infant oral health guideline integrating ECC prevention with life-course caries management through the Infinite Oral Health Care Programme. Early enrollment and sustained preventive care offer a population-level strategy to reduce the burden of dental caries and shift toward preventive dental attendance practices.

The economics of environmentally sustainable oral healthcare provision: a modified Delphi global consensus.

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Abstract

Background: Health systems are both vulnerable to climate change and significant contributors to it, accounting for 1–5% of global environmental impacts. The economics of sustainable healthcare remains understudied, a gap evident in oral health, where diseases affect over 3.7 billion people. The economic dimensions of environmentally sustainable oral healthcare (ESOH) remain inconsistently described, limiting evaluation and policy action, while remuneration models favour high-volume restorative care over prevention. A consensus definition and taxonomy are needed to compare studies, evaluate interventions, and inform policy.

Methods: We reviewed academic literature, professional organisation outputs, and global policy documents, applying Braun and Clarke's thematic analysis to generate candidate themes. These informed a two-round modified Delphi consensus via online survey, in which panellists rated theme relevance on a 9-point Likert scale; round 2 was refined based on round 1 feedback.

Findings: Of 52 invited multidisciplinary experts, 30 consented, 27 completed round 1, and 24 completed round 2. Consensus was reached on 26 themes (82% agreement in round 1; 80% in round 2). These formed a consensus definition framing economic of ESOH as the measurable impacts of delivering oral healthcare services in ways which preserve natural systems which uphold population oral health and well-being. It includes the use, and disposal, spanning financial, natural, human, and social resources, alongside the distribution of costs, benefits, and risks across populations and the governance structures shaping oral health outcomes. A four-domain taxonomy was developed: infrastructure and operations; oral healthcare delivery; technology, data, and innovation; and system-level governance and policy. These domains align with established health system frameworks, with emphasis on the economic and environmental implications of infrastructure, prevention-oriented care, and system-level financing.

Interpretation: This definition and taxonomy address a critical conceptual gap in ESOH, providing a foundation for evidence synthesis, guiding research priorities, and generating policy-relevant economic analysis.

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Dental Caries and its relationship with adherence to School Nutrition Policies among Public Primary School Children in Riyadh: A Cross-Sectional Study

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Abstract

Dental caries is one of the major global oral health problems today. It is a serious public health issue that makes achieving and maintaining oral health difficult across all age groups. Saudi Arabia has demonstrated a high prevalence of dental caries, and previous studies have highlighted the need for actions such as healthy foods at schools to reduce dental caries, since children spend a significant amount of their time in school. Saudi Arabia's school canteen policy has been mandatory since 2014 and bans certain foods in school cafeterias; however, previous studies suggest it still lacks clear guidance. This study aimed to explore the relationship between the adherence to school food policy and dental caries experience in public primary schools in Riyadh, Saudi Arabia. **Methods** A cross-sectional study was conducted among public primary school children in Riyadh, KSA. Parents were asked to complete a structured questionnaire to evaluate their child's oral health by using the World Health Organization (WHO) Oral Health Questionnaire for Children; the severity and prevalence of dental caries were assessed according to the WHO criteria. **Results** This study found no evidence of an effect of adherence to school food policies on either the severity or prevalence of dental caries, with (IRR = 0.96, 95% CI: 0.80, 1.17, p-value = 0.714), (OR = 1.01, 95% CI: 0.605, 1.69, p-value = 0.960). **Conclusion** There was no evidence of a relationship between the adherence to school food policy and dental caries experience in public primary schools in Riyadh, Saudi Arabia. However, because none of the schools examined demonstrated good compliance, a clear conclusion cannot be drawn.

Fibroblast-Derived Decellularised Extracellular Matrix as a Bioactive Additive for Osteogenic 3D Bioprinted Hydrogels

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Abstract

Background

Conventional gelatin–alginate bioinks used in 3D bioprinting lack the biochemical complexity of native extracellular matrix (ECM), limiting their osteogenic potential. Decellularised extracellular matrix (dECM) derived from cultured fibroblasts represents a promising bioactive alternative due to its matrix-associated proteins and biological signalling components. Fibroblast-derived decellularized ECM (dECM) may provide a scalable source of bioactive matrix cues for bone tissue engineering. This study optimized a fibroblast dECM preparation protocol and evaluates its effect following incorporation into 3D bioprinted hydrogels.

Methods

Human dermal fibroblasts were decellularised using optimised detergent-based protocols to maximise DNA removal while preserving extracellular matrix components. Decellularisation efficiency was evaluated using immunofluorescence imaging, dsDNA quantification, protein analysis, ECM preservation, protein composition were assessed using biochemical and proteomic profiling analyses. Lyophilised dECM was incorporated into gelatin–alginate bioinks for extrusion-based 3D bioprinting. Raman spectroscopy was performed on control hydrogels to evaluate matrix-associated biochemical signatures, while compressive stress–strain testing was used to assess hydrogel mechanical properties. Osteogenic potential was evaluated using alkaline phosphatase activity, RUNX2 expression, and mineralisation assays.

Results

Optimized decellularization effectively removed cellular material while preserving ECM-associated proteins. Proteomic analysis identified multiple matrix-associated proteins involved in extracellular matrix organisation and integrin-related signalling. Raman spectroscopy confirmed ECM-associated collagen- and glycosaminoglycan-associated peaks consistent with extracellular matrix-related biochemical components. dECM supplementation increased hydrogel stiffness, producing 33% increase in Young's modulus compared with control hydrogels while maintaining structural integrity and printability. Furthermore, fibroblast-derived dECM enhanced osteogenic responses, including increased alkaline phosphatase activity, enhanced RUNX2 expression, and mineral deposition

Conclusion

Fibroblast-derived dECM improved both the biological activity and mechanical performance of 3D bioprinted hydrogels. These findings support its potential as a scalable bioactive additive for enhancing bone tissue engineering constructs.

Keywords: Decellularized extracellular matrix; 3D bioprinting; osteogenesis; hydrogel; Raman spectroscopy; stress–strain analysis; bone tissue engineering

Baseline Clinical and Demographic Characteristics of Patients with Endodontic-Periodontal Lesions in a Multi-Omics Study

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Abstract

Background:

Endodontic-periodontal (EP) lesions involve a complex interaction between pulpal and periodontal tissues driven by microbial and systemic factors. Advanced metagenomic and metabolomic profiling of serum, saliva, gingival crevicular fluid (GCF), and root canal samples can clarify underlying disease mechanisms and treatment variations. To address this, we will profile these collected samples using metagenomics for microbial taxonomy and virulence genes, and metabolomics for host inflammatory and tissue degradation biomarkers.

Aim:

To evaluate the 12-month clinical outcomes, which will serve as the foundation for ongoing salivary microbiome and metabolomic analyses.

Methods:

In this longitudinal study, 50 patients with EP lesions were sampled over the course of their treatment. Clinical parameters, including probing pocket Depth (PPD) and gingival recession (REC), were recorded at baseline and 12 months. Clinical attachment level (CAL) for baseline and 12 months was computed as the sum of PPD and REC.

Results:

46% (n = 23/50) of the EP cohort presented with comorbidities, including hypertension, Type II diabetes, rheumatic disease, depression, and hypothyroidism. Most participants were diagnosed with generalized Grade C periodontitis (Stage III, n = 25; Stage IV, n = 18). Of the 82 identified EP lesions, the majority were Grade III (n = 57), and most (n = 76) showed no evidence of root damage. At the 12-month review, significant clinical improvements were observed. The mean PPD reduction was 1.97 mm, and the mean CAL gain was 1.86 mm.

Conclusion:

These findings highlight the treatment's clinical efficacy in reducing pocket depths and improving attachment levels. The 12-month clinical outcomes provide a sound foundation for interpreting subsequent microbiome and metabolomic analyses, ultimately linking molecular shifts to clinical periodontal recovery in EP lesions. Salivary microbiome and metabolomic analyses are currently underway and will be correlated with the clinical outcomes.

Identifying the High-Risk Oral Cancer Population – Studies from the Asia-Pacific Region

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Abstract

Background: Despite advances in contemporary management, oral cancer remains a lethal and deforming disease, with 5-year mortality rates persistent at around 50%, principally due to late presentation of advanced stage disease. Improvements in mortality and morbidity require earliest possible diagnoses and identification of individuals at risk of disease.

Methods: Retrospective Bayesian disease mapping studies were undertaken to identify spatiotemporal trends for oral cancer incidence and mortality. An initial study in Hong Kong utilised anonymized individual-level data for cancer diagnoses obtained from the Clinical Data Analysis and Reporting System of the Hong Kong Hospital Authority over 7 years: 2013 to 2019. A subsequent study in Australia obtained data from the Queensland State Cancer Registry between 1982 and 2018; Local government areas (LGAs) were utilized as geographical units to facilitate disease calculations.

Results: 3,341 oral cancer cases and 1,506 cancer-related deaths were identified in Hong Kong. Five districts exhibited considerably higher incidence risks with 1 significant 'case cluster' hotspot. Six districts displayed higher mortality than expected from territory-wide values. In Queensland, 9,887 oral cancer cases and 5,859 deaths were recorded. Twenty-one LGAs demonstrated higher oral cancer incidence than State average, particularly within rural and remote regions. Mortality was significantly higher in these regions with 3 remote LGAs exhibiting highest overall mortality risk in Queensland.

Implication for practice: Bayesian disease mapping is effective in identifying multiple incidence and mortality hotspots in defined populations. Such findings can be utilised to design primary, secondary and tertiary preventive strategies and interventional treatment to target the most 'at-risk' oral cancer populations within our communities.

Key message: Accurate identification of patient sub-populations at risk of oral cancer facilitates targeted prevention and early interventional treatment, offering pragmatic opportunities to reduce the burden of disease and improve both patient morbidity and mortality.

Genomics of Mouse Molar Tooth Development

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Abstract

Odontogenesis follows the sequential morphological stages characteristic of mammalian organogenesis, making tooth development an excellent model for studying organ formation. This study investigated transcriptomic dynamics during key stages of mouse molar development (bud, cap, and bell) using RNA sequencing (RNA-seq) data obtained from wild-type mouse embryos. The analysis identified substantial temporal changes in gene expression associated with major morphogenetic transitions and cellular differentiation processes.

Using the Galaxy platform, extensive differential gene regulation was detected across developmental stages, indicating complex spatiotemporal control of tooth morphogenesis. Gene expression differences between the bud and bell stages were more pronounced than those observed between intermediate transitions. DESeq2-generated volcano and MA plots highlighted consistent transcriptional changes in both magnitude and direction, reflecting dynamic cellular activity within developing tooth germs.

Functional enrichment analyses revealed significant involvement of key signalling pathways, including Wnt, BMP, FGF, and SHH, which are known regulators of tooth development. Protein–protein interaction networks generated using STRING identified functional gene modules essential for developmental progression and highlighted central regulatory genes such as *Pitx2*, *Lef1*, and *Wnt10a*, all of which have established roles in odontogenesis.

Comparison with previously published studies, particularly single-cell RNA-seq datasets, confirmed observed gene expression patterns and emphasized the importance of epithelial cell specificity and epithelial–mesenchymal interactions during tooth formation. The findings further underscore the critical role of transcriptional dynamics in enamel knot formation and cusp patterning, processes required for normal molar morphology.

Overall, this study advances understanding of the molecular mechanisms underlying tooth morphogenesis and organogenesis. These insights may contribute to future applications in regenerative dentistry, developmental dental disorders, and evolutionary biology. Further studies incorporating single-cell and proteomic approaches are recommended to validate and expand these findings.

SAFE-ALIGN: AI-Guided Clear Aligner Change Timing Under Variable Wear and Force Decay

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Abstract

OBJECTIVES: Clear aligner patients are commonly advised to change aligners at fixed intervals, despite variation in wear-time adherence, aligner force decay and tooth-tracking response. Premature progression may increase tracking failure, whereas unnecessary delay may prolong treatment. This study aimed to develop SAFE-ALIGN, a simulation-based artificial intelligence model for personalised aligner change decisions.

MATERIAL AND METHODS: A virtual clear aligner treatment environment was developed to simulate staged anterior tooth movement under variable patient adherence, biological responsiveness, force decay, tracking discrepancy and root-boundary safety risk. Hidden adherence patterns were modelled using a semi-Markov process and updated from noisy clinical observations, including self-reported wear time and aligner-fit scores. A partially observable decision model recommended four clinically interpretable actions: advance to the next aligner, extend current wear, reduce next-stage activation, or request clinical review. SAFE-ALIGN was compared with fixed 7-day, fixed 14-day and threshold-based go/no-go protocols in Monte Carlo virtual cohorts.

RESULTS: Preliminary simulations showed that fixed short intervals increased tracking failures in low-adherence profiles, while fixed long intervals reduced failures but introduced avoidable delay. SAFE-ALIGN adapted recommendations to the estimated adherence and tracking state, extending wear when estimated aligner force expression was insufficient and progressing when uncertainty was low. Safety constraints redirected high-risk cases toward reduced activation or clinical review.

CONCLUSION: SAFE-ALIGN introduces a safety-aware, clinically interpretable AI framework for personalising clear aligner change timing. By linking adherence estimation, force-decay modelling and progression decisions, this approach may support future remote monitoring workflows and prospective validation using anonymised clear aligner treatment records.

The consistency of AI-based programming platform in measuring enamel cracks' lengths

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Abstract

Objectives

To assess the consistency of AI based programming platform in measuring enamel cracks' lengths on 2D digital microscope images of natural and polished enamel compared to the digital microscope measurement tool as a gold standard.

Methods

Thirty-two specimens were included. Sectioning of teeth with water-cooled wafer diamond blades to form 2mm specimens. Specimens were checked under digital microscope and ones having at least one crack were included. Sixteen natural enamel specimens were bonded to resin blocks. Two human examiners blinded to the study aims were selected. The principal examiner recorded crack length using measurement function in millimeters (4 decimals). The second examiner wrote AI platform codes. Then, the principal examiner drew the same crack on the AI platform to be measured.

Results

Excellent reliability of the AI programming platform in measuring crack lengths was reported by ICC 0.998. The difference between human measurements and AI programming platform was significant. The reported mean difference was 0.023 mm (23 mm) (CI=95%). The measured cracks were from 0.5 mm to 3.5 mm.

Discussion

Despite the high reliability of the AI platform, significant difference in crack length (23 mm) was reported. This may be due to the principal examiner hand. However, this finding highlighted the ability of the AI platform to distinguish this small difference in crack length.

Conclusion:

AI-programming platform can measure enamel crack length with high reliability on two-dimensional images.

Keywords Artificial intelligence, coding, cracks, enamel, MATLAB.

Refining Mouthwash Simulation: The Influence of Turbulent Rinsing on the Surface Roughness of Resin-Composites After Toothbrushing

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Abstract

Background: The aim of the study is to evaluate and compare the effects of simulated toothbrushing, mouthwashing, and combined treatment on surface roughness of dental resin-composite using a new approach to refine mouthwashing simulation.

Materials and Methods: Twenty-two thin disc-shaped specimens (2 mm x 10 mm) of a universal resin-composite (EN-shade Transcend Universal Composite, Ultradent, USA) were divided into three groups: (a) Abrasive, (b) Abrasive-Erosive and (c) Erosive. Groups-a and b were performed on the same samples with profilometry in between them. Group-a was subjected to a simulation equivalent to five years of toothbrushing (18,100 cycles). For the mouthwashing (groups b and c), a newly developed capsule-mixing method was employed to simulate the turbulence during rinsing using mouthwash (Listerine Total Care Milder Taste Smooth Mint Zero Alcohol), and the 100 cycles, equivalent to 30s recommended by the manufacturer twice a day, was performed. The resin-composite roughness parameters R_a , R_p and R_q were evaluated for each group via non-contact profilometry (PROSCAN 2200, Scantron, UK). Surface profile of resin-composite and microhardness were recorded using optical microscopy (Struers Duramin-40) at 20x magnification coupling with Vicker's Hardness indentation.

Results: Shapiro-Wilk test shows changes in R_a , R_p and R_q for group a, b and c are in normal distribution ($p > 0.05$). T-test shows no significant difference between baseline and post-mouthwash for group c in R_a , R_p and R_q ($p > 0.05$). ANOVA also shows no significant difference for R_a , R_p and R_q ($p > 0.05$) across all treatment; baseline, post-toothbrush and post-mouthwash. T-test shows significant difference for R_a ($p = 0.01$) and R_q ($p = 0.03$) whilst R_p is statistically insignificant ($p = 0.10$). Independent T-test shows changes in R_a , R_p and R_q between group b and c are statistically insignificant ($p > 0.05$).

Conclusion: This study recommends re-evaluating the frequency of using the mouthwashes when methacrylate based universal resin-composite restorations, as EN-shade Transcend Universal Composite, are present.

How surfactants affect statherin micelles binding on natural teeth

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Abstract

Background and aim: previously we showed the calcium-induced self-assembly (micelle) of statherin which is a component of enamel pellicle. Although its binding to hydroxyapatite (HAP) has been demonstrated via its phosphorylation site, how it adheres to natural teeth remains largely unexplored, especially in combination with surfactants commonly found in toothpaste. This study aims to explore how surfactants affect statherin micelles binding to natural unpolished teeth.

Methods: extracted teeth, following treatment with bleach, were prepared for measuring the contact angle of deionized water before and after three surfactants (anionic sodium dodecyl sulfate, SDS; cationic dodecyltrimethylammonium bromide, DTAB and the non-ionic Triton X-100). Then each of tooth was cleaned and prepared for binding using synthetic or salivary statherin using whole mouth saliva. After doping of above four solutions on each tooth for 5 min and 30 min incubation with statherin, two buffers, TBST or EDTA, were used to sequentially elute bound proteins. TBST was used to break hydrophobic and EDTA for electrostatic interactions. Samples were separated by SDS-PAGE followed by quantification using immunoblotting .

Results: all surfactant-treated teeth had reduced contact angle of water compared to those doped in water. Compared to baseline binding before surfactant treatments, the main elution from teeth using synthetic statherin was EDTA whereas salivary statherin was mainly eluted by TBST. Furthermore, there was an overall decreased binding of salivary statherin after treatment of all surfactants while synthetic statherin binding showed surfactant-dependent changes compared to its baseline level.

Conclusion: surfactant treatments on natural unpolished teeth altered surface hydrophobicity regardless of the types of surfactants which affected statherin binding. Synthetic statherin behaved differently from salivary statherin suggesting other components of saliva also affect binding to teeth. On teeth, salivary statherin prefers to bind through hydrophobic interactions which are affected by surfactant treatments, implying toothpastes affect statherin binding on teeth.



ABSTRACT BOOK

Posters

Surface Matters: Dietary Acid-Induced Enamel Changes Influence Biofilm Architecture and Viability

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Abstract

Dental caries is a surface-mediated disease arising from dynamic interactions between tooth mineral, dietary chemical challenges, and microbial biofilms. While bacterial metabolism is central to lesion progression, the influence of dietary acid exposure on enamel surface properties and subsequent biofilm development remains poorly understood. Clarifying these early surface–biofilm interactions is essential for improving preventive strategies.

This study examined how citric acid concentration and pH modify hydroxyapatite (HAP) surfaces and how these changes affect *S. mutans* biofilm development. Polished HAP discs with standardised baseline roughness were assigned to six conditions: unexposed, phosphate-buffered saline (PBS), 1% and 6% citric acid (unbuffered), and 1% and 6% citric acid adjusted to pH 3.8 (buffered), modelling common dietary exposures. Post-treatment characterisation included surface wettability, roughness (Ra, Ry), and microhardness. Biofilm formation at 3 and 5 days was evaluated using crystal violet biomass quantification, confocal laser scanning microscopy (CLSM), and scanning electron microscopy (SEM).

Unbuffered citric acid exposure produced the largest reductions in water contact angle, consistent with increased surface roughness. Buffered acid treatments induced significantly greater alterations in roughness and microhardness. Despite pronounced physicochemical surface changes, crystal violet analysis showed no significant differences in total biofilm biomass between groups. However, CLSM revealed differences in biofilm architecture, including variations in live/dead ratios and exopolysaccharide production. Supported by SEM observations.

These findings indicate that acid-induced surface modification alters biofilm organisation and viability without proportionally increasing biomass, suggesting that caries risk may be influenced by physicochemical surface changes rather than microbial load alone.

Rethinking mouthcare in Parkinson's: co-designing support for everyday life

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Abstract

Background

People with Parkinson's (PwP) experience progressive motor and non-motor symptoms that can impair their ability to perform mouthcare activities and maintain oral health.

Aim

To co-design a mouthcare support programme with PwP, supporting the maintenance of oral health at home.

Methods

Inclusive recruitment engaged PwP (n=11), partners in care (n=1), and healthcare professionals (n=10). Broad inclusion criteria and minimal exclusions enabled participation from a diverse sample. Preferred communication methods and reasonable adjustments facilitated engagement.

Human-centred and inclusive design approaches were adopted, with a professional designer embedded within the project. Co-design activities were guided by the Design Council's Double Diamond and underpinned by the Behaviour Change Wheel. Activities were iteratively developed, drawing on co-design literature and supported by patient and public involvement (PPI). Participation was offered through postal, telephone, and digital formats.

Results

Flexible, multi-modal participation enabled engagement from PwP with varied needs. Iterative co-design increased participant confidence and depth of contribution, while inclusion of partners in care enhanced understanding of behaviours within everyday contexts.

Participants contributed to identifying challenges, facilitators, and potential solutions, prioritising and selecting strategies, and co-designing a prototype mouthcare support programme. Findings emphasise tailoring to individual capability, balancing independence with appropriate support, and embedding within daily routines.

Discussion and Conclusion

Integrating human-centred design with behaviour change theory enabled development of an intervention grounded in lived experience, designed for real-world use. This has potential to improve oral health behaviours, support self-management, reduce oral health inequalities, and contribute to the development of inclusive research methods for vulnerable groups.

Developing optical pathways for photodisinfection and photobiomodulation in root canal treatment

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Abstract

Objectives: Conventional endodontic treatment often fails to fully disinfect the root canal system, leading to persistent inflammation and tissue damage. Light-based photodisinfection and photobiomodulation may enhance microbial reduction and promote healing. This study evaluated whether endodontic materials can transmit 405 nm, 660 nm, and 810 nm laser wavelengths and act as optical pathways for light delivery.

Methods: Cylindrical blocks (1, 2, 3, and 15 mm thick) with or without a 2 mm central aperture were fabricated using a 3D printer (Crealiti 3D). The aperture was filled with gutta-percha or gutta-percha with bioceramic sealer. Five groups were tested: air (control), solid block, empty aperture, gutta-percha, and gutta-percha + sealer. Samples were positioned between a laser fibre and a power meter to measure transmitted power. Data were analysed using two-way ANOVA with Tukey post-hoc tests ($P < 0.05$).

Results: Empty apertures transmitted the highest laser power across all wavelengths and thicknesses. Solid blocks showed no transmission at 1 mm for 405 nm and only minimal transmission at 15 mm for 660 and 810 nm. Gutta-percha and gutta-percha with sealer blocked transmission at 1 mm for 405 nm and showed no transmission at 15 mm for 660 and 810 nm.

Conclusion: Empty channels allow the highest laser transmission, while gutta-percha and gutta-percha sealer block these wavelengths. Conventional endodontic materials cannot serve as optical pathways for therapeutic light delivery. Future research should focus on alternative materials or integrated optical fibre systems that enable effective light delivery to apical tissues.

Keywords: Endodontics, photodisinfection, photobiomodulation.

Public Perceptions of Sustainability in Dentistry

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Abstract

Background

Sustainability, defined as meeting present needs without compromising the ability of future generations to meet their own, has gained increasing attention in healthcare. In dentistry, this involves considering the clinical and cost-effectiveness of care alongside its environmental impact. Despite growing interest in sustainable healthcare, public perceptions of sustainability in dentistry remain under-explored.

Aim

To explore public perceptions of sustainability in dentistry.

Methods

This online questionnaire-based study was conducted at Dundee Dental Hospital and Research School (DDHRS). Ethical approval was obtained from the University's School of Health Sciences and Dentistry Research Ethics Committee. Patient and Public Involvement activities informed the questionnaire content, design, and mode of delivery. Individuals attending DDHRS over a 9-month period were invited to participate by scanning a QR code displayed on study materials located throughout the hospital. The questionnaire included open-ended free-text and multiple-choice questions. Data were analysed using IBM SPSS Statistics. Free text responses were thematically analysed.

Results and implications

One hundred and ninety-three participants completed the survey. The majority of participants (69%) were concerned with environmental issues. Almost three quarters (73%) either agreed or strongly agreed that their dental care should have as little impact on the environment as possible, with 67% willing to consider the environmental impact of their treatment. Understanding what changes to dental care people would accept, in the interest of sustainability, will be used to inform strategies for the delivery of more sustainable dental care in the NHS and contribute to informing wider recommendations for sustainability in dentistry, through national dental clinical guidance.

PicturePerfect: Exploring the prospective acceptability, perceived barriers, facilitators, and implementation considerations for hybrid dental care for children in UK primary and community dental settings — a qualitative study with dentists.

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Abstract

Background

Oral health inequalities remain a major public health concern for children in the United Kingdom. Increasing clinical demand, workforce pressures, and limited access to appointments across primary care and community dental services necessitate exploration of alternative models of care delivery. Hybrid dental care, combining face-to-face consultations with remote modalities, has shown potential to improve access and efficiency in healthcare. However, its application in paediatric dentistry remains underexplored, and clinician acceptability is not yet well understood.

Aim

To explore the acceptability, perceived barriers, facilitators, and implementation considerations associated with introducing hybrid dental care for children in primary and community dental settings in the UK.

Method

A qualitative study using semi-structured interviews with General Dental Council-registered dentists providing care for children under sixteen in primary care and community dental services across the UK is being conducted. Participants were recruited via purposive sampling. Interviews were conducted remotely, audio-recorded with informed consent, transcribed verbatim, and analysed using reflexive thematic analysis informed by the Theoretical Framework of Acceptability. Data collection is ongoing, with a target sample of 12–15 participants.

Results

Preliminary analysis of eight interviews indicates that dentists perceive hybrid care as a valuable approach for improving access and triage efficiency, particularly for preventive advice, follow-up, and non-urgent assessments. However, concerns were raised regarding diagnostic accuracy, safeguarding, digital exclusion, and increased workload. Participants emphasised the need for clear clinical guidance, training, and robust governance frameworks.

Conclusion

Early findings indicate cautious optimism toward hybrid paediatric dental care, alongside recognition of key clinical, ethical and organisational challenges. These insights will inform development of a safe, feasible, and acceptable model of care for children.

Salivary proteomic profiling in paediatric Behçet's disease: a pilot comparison with Crohn's disease, systemic lupus erythematosus and healthy controls

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Abstract

Background: Diagnosis of Behçet's disease (BD) in children and young people (CYP) is challenging. Recurrent oral ulceration is often the earliest and most prevalent sign, yet it is non-specific and shared with other conditions, including Crohn's disease (CD) and systemic lupus erythematosus (SLE). Salivary proteins may offer non-invasive diagnostic biomarkers for BD.

Aims: To identify BD-associated salivary proteomic signatures in CYP through comparison with CD, SLE and healthy controls (HC), and to map protein profiles to biological pathways.

Methods: Saliva samples from 40 participants aged 4–18 years (N=10 each: BD, CD, SLE, HC) were analysed using data-independent acquisition (DIA) mass spectrometry; 7 samples were excluded due to high missingness, leaving 33 for analysis (N=10 BD, N=8 CD, N=8 SLE, N=7 HC). CycLoess normalisation was applied and differential expression assessed using limma, adjusting for sex and age (Benjamini–Hochberg correction; FDR<0.05, |logFC|>0.5). Pathway-level analysis for BD contrasts used a rank-based gene set enrichment approach (Gene Ontology Biological Process).

Results: Global proteomic profiles (Principal Component Analysis and Multidimensional Scaling) showed no clear separation between groups. No proteins met significance thresholds in BD, whereas CD showed differential expression relative to controls (4 proteins; FDR<0.05, |logFC|>0.5) and SLE (10 proteins; FDR<0.05, |logFC|>0.5). Pathway analysis revealed enrichment of immune, antibacterial and complement pathways in BD, with relative depletion of metabolic processes compared to HC. Compared with SLE, BD showed enrichment of immune effector, type II interferon and complement pathways; no significant pathway differences were observed versus CD.

Conclusion: Although no individual proteins were identified to be associated specifically with BD, pathway-level differences suggest coordinated immune dysregulation. While these findings should be interpreted cautiously, further study in larger cohorts is warranted to clarify the potential of salivary proteomics in CYP with BD.

Promoting Shared Decision Making (SDM) to implement evidence-based practice: A feasibility study in dental primary care in Scotland

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Abstract

Background:

NHS constraints have intensified the need to prioritise effective, high-quality care. In the UK, despite limited evidence of clinical benefit, adult dental check-ups have traditionally been provided six-monthly, including a scale and polish. Moving away from this model requires dentists to adopt a new behaviour: risk-based recall intervals (RBRs). Research has identified multiple barriers to this, including patient expectations. The Choosing Wisely initiative promotes patient–clinician communication and shared decision-making (SDM) to reduce unnecessary interventions. Adopting this approach, this study developed and feasibility-tested a co-designed educational resource to support SDM in primary care dentistry, to enable the delivery of clinically effective, high-quality, and personalised care.

Methods:

A multi-method, in-practice feasibility study, underpinned by the Theoretical Domains Framework and the Theoretical Framework of Acceptability. Co-designed resources were implemented in NHS dental practices in Scotland. Data from patients and dental teams assessed the usability, acceptability, and practicability of the resources and explored awareness and perceptions of changes to care.

Results:

Four dental practices participated. In total, 226 patients completed an online survey and seven participated in follow-up interviews; 27 dental professionals were also interviewed. Overall, 59% of patients noticed the educational resources and 75% considered them useful. Awareness of national dental care changes was low; where it existed, changes were perceived as local practice decisions rather than national policy. Patients were accepting of RBRs once the assessment process was explained. Dental professionals felt responsible for justifying the changes. Patient–clinician relationships were central to acceptance, with trust considered more influential than formal guidance or evidence.

Conclusions:

This Scotland-based feasibility study involved a small number of self-selecting practices, limiting transferability. Findings suggest that successful implementation of RBRs depends on patient education, trust, and locally tailored communication. The co-designed resources were acceptable and feasible, primarily supporting dental teams in communicating changes to care.

Chlorhexidine release from vinyl polysiloxane for formulation of a novel implant prosthesis screw channel sealing material

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Abstract

Objectives: To investigate whether chlorhexidine diacetate (CDA) can be incorporated into vinyl polysiloxane (VPS) materials and released from the silicone matrix, as an initial step towards development of a novel VPS-based material with antibacterial properties and sealing capacity, for sealing the implant prosthesis screw channel.

Methods: CDA was incorporated at 5 wt% into three commercially available VPS materials: Aquasil Ultra-Light Body (M1), Elite HD-Light Body (M2), and Memosil 2 (M3). Fourier-transform infrared spectroscopy (FTIR) was used to assess whether CDA incorporation altered the main chemical characteristics of the materials. Disc specimens (10mm in diameter × 2mm in thickness; n=6 per material) were immersed in phosphate-buffered saline at 37°C, and CDA release was quantified by UV–Vis spectrophotometry over 28 days. Results were expressed as mean ± standard deviation.

Results: FTIR spectra showed the characteristic siloxane peaks of VPS materials, with no obvious change in the dominant backbone bands after CDA incorporation. UV–Vis analysis confirmed that CDA was released from all tested materials, although the extent and duration of release varied according to the VPS matrix. M1 showed the highest release profile, reaching 12.39 ± 2.45 mg/L at Day 3 and remaining highest at Day 28 (3.81 ± 0.56 mg/L). M3 showed intermediate release (6.35 ± 2.23 mg/L at Day 3; 1.95 ± 0.27 mg/L at Day 28), whereas M2 showed the lowest release (1.63 ± 0.55 mg/L at Day 3; 0.65 ± 0.25 mg/L at Day 28).

Conclusion: CDA was successfully incorporated into VPS materials and released over 28 days without obvious alteration of the dominant VPS backbone (FTIR). Among the tested materials, M1 showed the most promising release profile and may provide the most suitable basis for future development of a novel antibacterial VPS sealing material for implant prosthesis screw channel.

Teriparatide Use in Medication-Related Osteonecrosis of the Jaw: Meta-Analysis

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Abstract

Purpose

Medication-related osteonecrosis of the jaw (MRONJ) is a complication of antiresorptive and antiangiogenic therapies. Teriparatide, a recombinant parathyroid hormone analogue with anabolic bone effects, has been proposed as treatment, though optimal dosing remains unclear. This review compares daily versus weekly regimens for clinical outcomes and adverse effects and identifies limitations to guide future research.

Methods

A structured critical review was undertaken following the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) guideline using predefined key words, inclusion and exclusion criteria based on a PICO framework across three scientific servers. Studies evaluating daily or weekly teriparatide for MRONJ were included. Extracted data comprised patient demographics, MRONJ stage, treatment protocols, clinical and radiographic outcomes, biochemical markers, and adverse events. Methodological quality was assessed using Joanna Briggs Institute (JBI) tools, with bias evaluation performed. A random-effects meta-analysis estimated pooled clinical resolution rates and compared dosing regimens utilising clinically homogeneous data.

Results

Of 370 studies screened, ten (172 patients) met inclusion criteria. Daily teriparatide was used in 145 patients (84.3%) and weekly in 27 (15.7%). In three direct comparison studies, daily dosing demonstrated higher pooled MRONJ resolution post-treatment (91.4% vs 79.6%; OR = 2.59, 95% CI 0.59–11.40; $p = 0.206$) and at follow-up (98.8% vs 89.8%; OR = 2.32, 95% CI 0.33–16.30; $p = 0.849$), without statistical significance. Weekly dosing showed higher rates of nausea/vomiting (41.7% vs 3.4–35.3%) and musculoskeletal symptoms (58.3% vs 3.4–29.4%).

Conclusion

Teriparatide shows promise as an adjunctive treatment for MRONJ. Although daily dosing showed slightly higher, more consistent healing rates, current evidence does not demonstrate superiority over weekly dosing. Where effectiveness appears comparable, treatment choice may depend on patient preference, cost, and practical considerations. Powered randomised controlled trials with direct comparison are required to determine optimal dosing strategy and clarify long-term efficacy and safety.

Assessing if Maternal Exposure During Pregnancy Affects the Severity of Cleft Palate

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Abstract

Aims: Cleft lip ± palate (CLP) is a common congenital craniofacial anomaly with significant functional and psychosocial impact. While maternal exposures are known to influence CLP occurrence, their role in determining severity remains poorly understood. This study assessed whether folate supplementation, body mass index (BMI), smoking, alcohol consumption, and drug use during pregnancy are associated with cleft severity, measured by cleft width and Veau classification.

Methods: Data were drawn from The Cleft Collective cohort study of infants with non-syndromic CLP. Linear regression was used for cleft width and ordinal logistic regression for Veau classification, with models adjusted for maternal age, infant sex, and relevant co-exposures. Sex-stratified analyses were also performed.

Results: Maternal folate supplementation was associated with evidence for reduced odds of higher Veau classification in the fully adjusted model (OR = 0.765, 95% CI: 0.595–0.984; $p = 0.04$; $n = 1,172$), suggesting a protective effect on anatomical severity. No evidence for association was found between folate and cleft width ($\beta = -0.400$ mm; $p = 0.48$; $n = 447$). Higher maternal BMI was associated with slightly increased cleft width in female infants ($\beta = 0.091$ mm; $p = 0.02$; $n = 201$). Maternal alcohol consumption was associated with higher odds of more severe Veau classification in female infants (OR = 1.463, 95% CI: 1.022–2.093; $p = 0.04$). Smoking and substance use showed no evidence for associations with either severity measure.

Conclusions: Maternal folate supplementation is associated with reduced anatomical severity of CLP, reinforcing the importance of periconceptional folic acid intake beyond its role in neural tube defect prevention. Sex-specific effects of BMI and alcohol warrant further investigation. These findings have implications for prenatal counselling and contribute to the evidence base on modifiable determinants of CLP severity.

Vitamin D Modulates Cytokine Secretion from Gingival Epithelial Cells Under Inflammatory Stimulation

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Abstract

Background:

1,25-dihydroxyvitamin D₃ (1,25(OH)₂D₃), exerts immunomodulatory effects in multiple immune cell types; however, its role in gingival epithelial inflammatory responses remains incompletely characterised. The study aimed to investigate the effects of 1,25(OH)₂D₃ on the modulation of cytokine secretion from human gingival epithelial cells following inflammatory stimulation.

Materials and Methods

Immortalised human gingival keratinocytes (OKG4/bmi1/TERT) were stimulated with tumour necrosis factor-α (TNF-α; 10–50 ng/mL) or *Porphyromonas gingivalis* lipopolysaccharide (*P. gingivalis* LPS; 1 µg/mL) for 3 h or 24 h to model acute and sustained inflammation. Cells were subsequently treated with 1,25(OH)₂D₃ (10⁻⁸ M) or vehicle control (0.1% ethanol). Secretion of IL-8, IL-6, IL-1β, and TNF-α was quantified by Enzyme-Linked Immunosorbent Assay (ELISA).

Results

TNF-α induced a clear concentration-dependent increase in IL-8 and IL-1β secretion, confirming preserved inflammatory responsiveness of OKG4 cells. Cytokine secretion was greater at 24 h compared with 3 h, indicating time-dependent amplification of epithelial activation. In contrast, *P. gingivalis* LPS elicited comparatively modest cytokine secretions, with limited IL-8 secretion and minimal IL-1β secretion at 24 h. Treatment with 1,25(OH)₂D₃ consistently reduced IL-8 and IL-1β secretion following TNF-α or *P. gingivalis* LPS stimulation, although these reductions did not reach statistical significance. The reduction trend was more evident following prolonged stimulation.

Conclusion

1,25(OH)₂D₃ attenuated pro-inflammatory cytokine secretion in gingival epithelial cells. TNF-α stimulates stronger cytokine secretion from epithelial cells compared to *P. gingivalis* LPS, highlighting stimulus-specific inflammatory regulation. These findings support a potential role for vitamin D in modulating epithelial immune responses relevant to periodontal disease.

Biochemical Alterations in Extracellular Vesicles for Oral Cancer Diagnosis: A Comparative Study

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Abstract

Objective: Oral Squamous Cell Carcinoma (OSCC) remains a clinical challenge, with survival rates seeing little improvement over the last four decades. Tissue biopsy is the diagnostic gold standard, its invasive nature limits longitudinal monitoring. Salivary liquid biopsy has emerged as a minimally invasive alternative. Within saliva, extracellular vesicles (EVs) are of high interest as they carry molecular cargo reflective of their parent cells. Chemical characterisation of EVs via Fourier-transform infrared (FTIR) spectroscopy can provide a molecular "fingerprint" for early detection. This study aimed to characterise FTIR spectral profiles of EVs from malignant and healthy oral keratinocytes to evaluate their diagnostic potential.

Methods: EVs were isolated from malignant (CAL27) and healthy (TIGK) oral keratinocyte cell lines using four methodologies: ultrafiltration (UF), combined UF and precipitation (UF+T), ultracentrifugation (UC), and a precipitation kit (T). Characterisation was performed using nano-flow cytometry for particle size and BCA assays for protein concentration. FTIR spectra were recorded in the 4000–400 cm^{-1} range, focusing on peaks at $\sim 1600 \text{ cm}^{-1}$ (proteins) and $\sim 2900 \text{ cm}^{-1}$ (lipids). The lipid-to-protein ratio was then calculated for biochemical characterisation.

Results: Nano-flow cytometry revealed a smaller average size in cancer-derived EVs (137.0 nm) compared to normal EVs (147.0 nm). A consistent pattern was observed where cancer EVs expressed lower lipid levels and a lower lipid-to-protein ratio compared to normal cells. This trend was consistent across high-purity techniques (UF, UF+T, and UC), whereas the precipitation kit co-isolated lipid particles. Quantitative analysis showed increased protein content per particle in cancer samples, nearly doubling in some isolation groups.

Conclusion: These preliminary findings demonstrate that oral cancer-derived EVs possess distinct chemical signatures characterized by reduced lipid content and increased protein concentration. These results suggest the potential of using EV chemical signatures as a non-invasive diagnostic tool for OSCC.

Proteomic Characterisation of Human Dental Enamel Protein under Different Etching Conditions

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Abstract

Background: Dental enamel is the most highly mineralised tissue in the human body, consisting primarily of carbonated apatite with a minor but functionally important organic matrix. Although present in trace amounts in enamel, residual proteins and peptides contribute to structural integrity, influence the demineralisation process, and may serve as potential biomarkers. This study aimed to characterise the proteomic composition of enamel matrix protein extracted from teeth under different conditions and to assess variations in protein profiles associated with enamel status.

Methods: Freshly extracted teeth collected from patients attending Birmingham Dental Hospital and teeth from the Dental Research and Tissue Biobank (University of Birmingham) were used in this study. Samples were classified using the ICDAS score. Enamel samples were processed across different etching conditions and caries status. Enamel powder was generated using a high-speed device with water cooling, then digested with trypsin using the filter-aided sample preparation (FASP) method. Proteins were subsequently identified using LC-MS/MS analysis.

Results: Distinct and shared protein profiles were observed across different etching conditions. 10% trifluoroacetic acid [TFA] for 2 seconds resulted in no detectable shared proteins. Longer etching (10% TFA, 5 min) and phosphoric acid treatment (37%, 30 s) identified 16 shared proteins, including albumin, keratins, collagen, and ameloblastin. Analysis of deeper enamel layers without performing additional etching has three shared proteins, including collagen and ameloblastin.

Conclusion: This study demonstrates the variability in enamel proteomic profiles influenced by etching condition and sample origin. Variations of extraction conditions influence protein detection, highlighting the importance of methodological standardisation. The identification of both shared and unique proteins across different etching condition, such as ameloblastin, suggests that, despite their low abundance, enamel matrix proteins can be detected under optimised conditions.

Keywords: Dental enamel; Etching; Enamel protein; Mass spectrometry Proteomic.

Electrospun PLA/Silk Fibroin–Ceria Nanocomposite Scaffolds for Oral Soft Tissue Repair

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Abstract

Background:

Oral and maxillofacial soft tissue defects remain difficult to manage because healing may be delayed, poorly organised and associated with scar formation. Dental biomaterials that mimic the extracellular matrix while providing mechanical support and antibacterial protection may improve regenerative outcomes. Electrospun nanofibrous scaffolds are particularly attractive because their architecture can be tailored to support tissue guidance and repair. This study aimed to develop and characterise electrospun poly(lactic acid) (PLA)/silk fibroin nanocomposite scaffolds incorporating cerium oxide-based doped nanoparticles for potential application in oral soft tissue regeneration.

Methods:

Random and aligned nanofibrous scaffolds were fabricated using electrospinning. Scaffold structure and composition were assessed using scanning electron microscopy, Fourier-transform infrared spectroscopy and X-ray diffraction. Physicochemical performance was evaluated through wettability, swelling, porosity, density and in vitro degradation testing. Antibacterial activity and mechanical behaviour under dry and hydrated conditions were also examined to determine their suitability as dental regenerative materials.

Results:

The fabricated scaffolds showed continuous nanofibrous morphology, with clear differences between random and aligned fibre arrangements. The aligned configuration provided a more organised architecture, which may be beneficial for guided soft tissue support. The composite scaffolds demonstrated favourable wettability, swelling, porosity and density, suggesting a microenvironment suitable for future cell attachment and tissue integration. In vitro degradation indicated acceptable scaffold stability, while antibacterial testing suggested an added protective function. Mechanical assessment further supported their potential handling and functional performance under clinically relevant hydrated conditions.

Conclusion:

Electrospun PLA/silk fibroin scaffolds incorporating cerium oxide-based nanoparticles demonstrated promising structural, physicochemical, antibacterial and mechanical properties. These findings support their potential as advanced dental biomaterials for oral and maxillofacial soft tissue repair. Further biological testing is required to confirm cell response, regenerative performance and translational suitability.

Using a collaborative approach to create a mentorship model for use in UK Dental Practice

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Abstract

Mentorship in dental practice offers positives outcomes, affecting not only clinicians experience, confidence and enjoyment but also patient care. It also reduces feelings of isolation in clinical practice and aids job retention, supporting career development whilst aiding personal growth. UK dentistry does not offer structured mentorship schemes for all professional roles. This inequality limits access to mentorship for some and does not promote professional inclusivity. To have a mentorship model freely available for all in UK dental practice may improve this.

This PhD research aims to create a mentorship model for UK dental practice using a collaborative approach which involves Dentists, Dental Hygienists and Dental Therapists. This research has three objectives:

Objective 1: To collect and synthesise evidence of models used for mentorship worldwide in dentistry and identify how mentorship models are created via systematic scoping review.

Objective 2: To understand the barriers and facilitators Dentists, Dental Hygienists and Dental Therapists experience relating to mentorship in UK dental practice via a questionnaire.

Objective 3: To formulate a mentorship model for use in UK dental practice using a collaborative approach and input from Dentists, Dental Hygienists and Dental Therapists.

This presentation will offer an overview of this research and offer the findings of the systematic scoping review. This scoping review identifies the use of the Mentor- Protégé model as part of a dental hygiene curriculum in the USA. The findings highlight the available mentorship models in other sectors and potential use in dentistry; but these require using other models alongside to meet dental needs. This research will offer empirical knowledge on the barriers and facilitators of mentorship in UK dental practice; it will inform how a mentorship model can be created and offer a model for use in UK dental practice.

Designing a Microenvironment for Tooth Bioengineering

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Abstract

A biological approach to tooth replacement through bioengineering offers a promising alternative to conventional restorative therapies. Tooth development is orchestrated by reciprocal interactions between epithelial and mesenchymal cells during embryogenesis, regulated by multiple signalling pathways. However, embryonic cells capable of inducing tooth formation lose this inductive potential when expanded *in vitro*. Previous studies have shown that inductive cells can restore lost odontogenic capacity, indicating the essential role of cellular communication. Extracellular vesicles (EVs) are key mediators of cell-to-cell communication and may contribute to the re-induction of odontogenic potential.

Objective: Identify the cellular and molecular mechanisms underlying the loss of tooth-inducing capacity, and restore this potential using small molecules and EVs, while designing a suitable microenvironment for bioengineered tooth primordia.

Methods: Single and combined small-molecule treatments (BIO, SML2087, BCI, and Purmorphamine) were applied to non-odontogenic cells to assess their effects on odontogenic gene expression via activation of the Wnt/ β -catenin, BMP, FGF, and SHH pathways. EVs were isolated and characterised from embryonic odontogenic tissues. Functional analysis was conducted using an exosome inhibitor (GW4869). Collagen-based scaffolds were evaluated for their ability to support tooth organoid formation.

Results: Small-molecule treatments increased expression of several tooth-related genes; however, levels remained lower than in primary odontogenic cells. EV analysis revealed particles averaging 97 nm, with a concentration of 5.151×10^{10} particles/ml and protein concentration of 30.2 μ g/ml. Transmission electron microscopy confirmed exosome morphology, and CD63 positivity indicated a biologically relevant EV population. Inhibition of EV release resulted in undefined rounded structures in 3D culture.

Conclusion: Small molecules partially restored odontogenic gene expression, while EV profiling suggests active secretion of small EV with a potential role in restoring tooth-inductive capacity. Future work will focus on proteomic analysis of EVs to guide strategies for restoring the odontogenic potential of adult stem cells within optimised scaffolds.

Exploring Dental Educators' Perspectives on Key Domains of the GDC Safe Practitioner Framework – A qualitative study

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Abstract

The General Dental Council launched new guidance for dental educators called 'The Safe Practitioner framework (SPF), a framework of behaviours and outcomes for dental professional education' (GDC, 2023) which replaced the previous 'Preparing for Practice guidance' (GDC, 2015). The framework introduced the concept of behaviour monitoring in dental students. **Aim:** The aim of this research was to investigate how those involved in the education and supervision of students across UK dental schools understand, monitor and assess certain aspects of the new GDC guidance which specifically relate to behaviours. **Methods:** A qualitative research design with data collected using semi-structured interviews. Data analysis adopted a thematic analysis approach. Participants included twelve dental educators from seven different UK Dental Schools. **Results:** Four different themes were identified and encompassed how different educators perceive behaviour, attitude and professionalism. Cultural and generational differences in the interpretation of professionalism were also highlighted. The role of reflection in dental education was identified as an evolving element of teaching & learning. Finally, there was a lack of consistency in the current systems of monitoring and calibration of assessment of essential non-clinical skills. **Conclusion:** This research highlights the varied perceptions and challenges faced by dental educators when considering implementation of the SPF, particularly around behaviour monitoring. Recommendations include the need for clarity in terminology, improved educator training, and reliable and valid assessment systems to align with SPF outcomes. As UK dental schools integrate the SPF into their curricula, further research is needed to evaluate the longer-term impact on educators, students and dental schools of behaviour monitoring in dental students.

Not just a pretty face; Exploring adolescent motivation for oral hygiene during orthodontic care.

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Abstract

Introduction: The reported benefits of orthodontic treatment include improvements in oral health. Yet, oral hygiene is framed as a challenge for adolescent orthodontic patient and their practitioners. Current approaches to oral hygiene support with adolescent orthodontic patients emphasise the risks of poor hygiene and the role of practitioners to provide motivation and seek compliance or adherence with instructions. There is little in the evidence base from young people about their motivation to care for their own teeth during and after orthodontic treatment and how their motivation is supported.

Objectives: To learn from young people about their motivation for oral hygiene self-care during this care pathway to inform how orthodontic professionals can support their oral hygiene self-care.

Methods: Semi-structured interviews were conducted with 14 participants (aged 16–19) who had recently completed orthodontic treatment. Using the 5D model of Appreciative Inquiry, participants reflected on their experiences and motivations for oral hygiene during treatment. The interviews were digitally recorded and transcribed verbatim.

Results: Reflexive thematic analysis explored the continuum of motivation—from externally regulated compliance to internally regulated, self-concordant behaviours, suggesting that adolescent motivation for oral hygiene self-care is multifaceted and relational. Participants appreciated affirmation, respect and support in addressing the challenge of maintaining good oral hygiene during the ebb and flow of orthodontic treatment.

Discussion: Adolescents expressed self-concordant motivation towards oral hygiene in addition to attaining the aesthetic benefits of orthodontic treatment. Self concordance has not previously been explored in the orthodontic literature. Self-concordance is associated with sustainable habits and wellbeing. This research informs ways practitioners can reframe their role from motivators and providers to partners in adolescent patient centred care pathways, co-creating health outcomes and supporting oral health and overall wellbeing.

Exploring the barriers to providing dental care in care homes in England - A systematic literature review

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Abstract

As the UK population increases, those who are living in English care homes were around 370,000 based on the latest figures from the Office of National Statistics (2023) with the Care Quality Commission (CQC) arguing that dental care is not sufficient for this particular population (Walford, 2024). **Aim:** With higher levels of need among those living in care homes, and the complexity of long-term conditions, accessing dental care can be particularly challenging. Although this is widely recognised as an area of difficulty, there remains a need for a systematic review of the literature to clearly identify the barriers to providing dental care for care home residents in England, and to help clarify the measures needed to improve access and quality of care which was the aim for this study. **Method:** A systematic literature review was used to provide a rigorous and reproducible approach to critically analyse all the available literature. Six databases were searched including DISCOVER, AMED, CINAHL Complete, Medline, British Nursing Collection and Cochrane using keywords with clear inclusion and exclusion criteria. Each relevant paper was then identified using PRISMA and critically appraised using CASP tools. The results were then thematically analysed using Braun and Clarke's (2006) Six Step thematic analysis approach. **Results:** Seventeen papers met the systematic search criteria and three main themes were identified including; barriers to care, facilitators to care and collaboration. Results showed that education, training, access and funding influenced the provision of care and impacted on the consistency of offering such care. Potential areas for improvements were also identified. **Conclusion:** This systematic literature review highlights the barriers to accessing dental care to this vulnerable group based on current available research. There are innovations that could be in place if the political and structural desire is there to implement them.

Engaging dental teams in research: What topics most interest dental teams?

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Abstract

Background

Research to understand why it is so hard to recruit general dental practice teams to research studies uncovered a range of factors which are important. Personal interest in the topic and the wider benefit that they perceive will result from research specific issues was identified as a key issue. This study aimed to explore what potential research areas interest members of general dental teams in England.

Method

An online survey of general dental teams was distributed in January 2026 using the Qualtrics Platform via the social media groups For Dentists, By Dentists and Dental Hygienist & Therapist Network.

Results

53 respondents consented to participate, of which 34 were dentists and 19 other members of the dental team. The most popular areas of general dentistry identified were restorative (including periodontal care) and aesthetics. The least popular areas were unscheduled care and special care dentistry. A range of interest levels existed in the topics found to be of personal interest. Behaviour change of public/patients and oral disease were the most popular. The business of dentistry was the least popular topic.

Conclusions

Dental team members are interested in a range of research topics. Focusing recruitment to appeal to those who have most interest in a topic seems an obvious strategy. Research in the field of restorative dentistry which involves changing patient and public behaviours seems likely to be the most successful in recruiting dental teams to take part.

Knocking Out SAA 1/2 Alters the Transcriptional and Secretory Profile of Periodontally Challenged Oral Epithelium

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Abstract

Microbial invasion of the gingival epithelium is a key step driving chronic inflammation and immune dysregulation in oral and systemic tissues. Serum amyloid A (SAA) is an acute-phase protein released from epithelial tissues in response to infection. At epithelial barriers, SAA1 has diverse functions, including opsonisation of bacteria, regulation of TLR-signalling and regulation of cell-mediated immunity. Our aim is to characterise how epithelial cells respond to oral bacteria in the presence and absence of SAA1. CRISPR-Cas9 technology was used to delete the SAA1 gene from TR146 cells to generate SAA knock-out (KO) TR146. This novel cell line was infected with *S. intermedius*, *F. nucleatum* and *P. gingivalis*. Immune responses were investigated using qPCR and ELISA assays. Knocking out SAA1 induced a distinct transcriptional shift, significantly upregulating MPO, NLRP3, and JUN ($p < 0.05$). Infected wild-type (WT) cells showed significantly higher expression of IRF7, CAMP, and MPO compared to infected KO cells ($p < 0.05$). Among the pathogens tested, *F. nucleatum* revealed the most transcriptional and translational changes in both WT and KO cells. Notably, infected WT cells significantly expressed and produced IL-1 β (49 pg/mL) in response to *F. nucleatum* compared to the infected KO cells (25 pg/mL, $p < 0.0001$) and uninfected WT cells (4.9 pg/mL, $p < 0.0001$). These findings highlight SAA1 as a critical orchestrator of gingival epithelial immunity, particularly in regulating cytokine production and antimicrobial defences. Its absence fundamentally shifts the inflammatory environment, suggesting that SAA1 is a key modulator in the progression of periodontal and associated systemic diseases.

Characterisation of the Effect of Platelet-Rich Fibrin on Macrophage Polarisation and Interaction with Osseointegration

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Abstract

Aims and Objectives. Explore the mechanisms of potential influence of I-PRF on osseointegration and inflammatory responses at sites of dental implants. objectives characterise the immune and growth factor constituents of I-PRF. determine the influence of I-PRF on inflammatory cell polarisation and functions that promote bone formation and repair.

Materials and Methods. THP-1 human monocytic cell line was used as a model system for studying macrophage inflammatory differentiation following treatment with different polarising stimuli. Phorbol 12-myristate 13-acetate (PMA) followed by EITHER proinflammatory-promoting IFN γ + and LPS OR pro-resolving IL-4. Changes in cell phenotype were monitored with microscopy, flow cytometric monitoring of surface protein marker and changes in gene expression. I-PRF Conditioned Medium (CM) was prepared from I-PRF. Then used in characterization assay studies or cell differentiation influenced by I-PRF

Results

Microscopy showed cells treated with PMA became plastic-adherent, resulting in increased cell cytoplasmic volume as indicated by greater forward scatter by flow cytometry.

Post-PMA treatment with M1 polarising stimuli (LPS and IFN- γ) reduced cell size and resulted in an increase in some markers: CD80, CD209, HLA-DR and CD14 phenotypes. Whereas with M2 polarising stimulus, IL-4 decreases in others' CD80, HLA-DR, and CD14. THP-1 macrophage model has been successfully replicated.

Following treatment with i-PRF, M1 macrophages typically induce a downregulation of CD80 and HLA-DR, signifying a robust immunomodulatory reprogramming. Five healthy donors have been used to generate I-PRF stored ready for the next steps. Key growth factors associated with I-PRF include VEGF, PDGF-BB, TGF- β 1, EGF, bFGF, and cytokines (TNF- α , IL-1 β , IL-6, IL-4, IL-10) currently ongoing using ELISA and multiplex bead arrays

Conclusions

We demonstrated our protocol changes the morphology and phenotype of THP-1 cells and their behaviour in terms of adherence and surface protein markers and the protocol for generating I-PRF reproducibly. Also, we demonstrated that I-PRF can influence the maturation M1 macrophages.

Effect of Artificial Saliva Ageing on the Mechanical and Shape Recovery Behaviour of 4D-Printed and Thermoformed Orthodontic Aligner Materials

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Abstract

Aim: To evaluate artificial saliva ageing effects on the flexural, surface mechanical, and shape-recovery behaviour of five 3D-printed aligner materials compared with a thermoformed PETG control over 14 days.

Methods: Bar-shaped specimens of 3D-printed materials, Clear-A V2/Senertek, OD-Clear /3Dresyns, TC-85DAC/Graphy, DAC, and DAC Pro/LuxCreo and a thermoformed PETG control (GT FLEX) were aged in artificial saliva for 0, 7, and 14 days, $n = 6$. Flexural (maximum load at 2mm, modulus, and stress) were measured by 3-point bending; surface mechanical properties by Vickers indentation at 4.9 N for indentation modulus (EIT), indentation creep (CIT) and indentation relaxation (RIT) according to ISO 14577; shape recovery was assessed at 67 C. Following a non-normal distribution, Kruskal-Wallis and Dunn-Bonferroni post-hoc tests were used ($\alpha = 0.05$).

Results: PETG's flexural properties remained stable across ageing ($p > 0.05$) and were the highest at Days 7 and 14. Maximum load and flexural stress decreased by Day 7 in TC-85DAC and OD-Clear and by Day 14 in Clear-A V2 ($p < 0.05$); DAC showed significant increases in all three flexural parameters by Day 14 ($p < 0.05$); DAC Pro remained unchanged. EIT decreased significantly by Day 14 in PETG, TC-85DAC, Clear-A V2, and OD-Clear ($p < 0.05$), whereas DAC and DAC Pro were unaffected. PETG's CIT decreased with ageing ($p = 0.009$); TC-85DAC had the highest CIT, and OD-Clear had the highest RIT. Shape recovery was stable in TC-85DAC and OD-Clear but declined in PETG, DAC, and DAC Pro. Clear-A V2 retained the most favourable flexural profile, corresponding to about 60% of PETG's force at Day 14.

Significance: Artificial saliva ageing produced material-dependent changes in aligner performance. Compared with PETG, the 3D-printed materials generally showed lower mechanical stability and greater CIT and RIT, although ageing responses varied among materials. These findings support further optimisation before clinical application.

Dental tourism: investigating peer-to-peer information sharing in social media communities.

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Abstract

Introduction: Dental tourism refers to travelling overseas to receive dental care. It is driven by lower treatment costs, shorter waiting times, and limited access to dental services in home countries. In the UK, rising private dental fees and reduced availability of NHS dentistry have contributed to increasing dental treatment abroad. Social media platforms have become important spaces where prospective dental tourists seek information, share experiences, and exchange advice. Peer-to-peer interactions may influence decision-making, shape perceptions of risk, and contribute to the spread of both experiential knowledge and misinformation. However, there is limited research examining the information being consumed and shared within dental tourism-focused social media communities. The aim of this study was to understand what information people are consuming and sharing in special-interest Facebook groups related to dental tourism.

Methods:

A content analysis was conducted of publicly accessible Facebook groups dedicated to dental tourism in countries commonly accessed by UK dental tourists. A systematic search identified 58 groups. Eight met the inclusion criteria. Data were extracted from posts shared between 24 May and 24 August 2025. In total, 410 posts and 279 comments were analysed. Descriptive statistics quantified engagement. Inductive and deductive thematic analysis was undertaken to identify recurring themes.

Results:

Facebook dental tourism groups functioned as peer-to-peer forums where users sought advice, shared lived-experiences, and provided guidance to others. Advice-seeking was most common, relating to clinic recommendations, treatment decisions, and costs. Negative experiences and complications generated high engagement. However, the predominance of non-professional advice and promotional content raised concerns regarding misinformation, patient safety, and the limited visibility of professional guidance.

Conclusion: Online peer communities are a key source of dental tourism information used to support decision-making. The findings highlight how people commonly seek lived experience in preference to professional advice.

Artificial Intelligence in Dentistry: Implications for Access, Oral Health Inequalities, and Dental Education

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Abstract

Artificial intelligence (AI) is reshaping dentistry through applications in diagnostic imaging, disease risk prediction, treatment planning, patient communication, and digital education. In the context of rising demand for dental services, workforce pressures, and oral health inequalities, AI offers opportunities to support more timely, efficient, and personalised oral healthcare. However, its impact on equity remains uncertain, where digital exclusion, socioeconomic disadvantage, and algorithmic bias may limit its benefits for underserved populations.

This evidence-based narrative review explores the role of AI in improving access to oral healthcare, reducing oral health inequalities, and strengthening dental education. Evidence indicates that AI-supported tools enhance early detection of oral diseases, assist remote screening and triage, support preventive care, and improve patient engagement through personalised communication. These applications may be valuable in communities experiencing barriers to dental care, including limited service availability, geographical isolation, or low health literacy. For underserved and digitally or socially excluded populations, AI-enabled remote screening, multilingual patient communication, and risk-based triage may help identify oral health needs earlier and connect individuals to appropriate care pathways.

AI has potential in dental education. Adaptive learning platforms, simulation-based training, automated feedback, and AI-assisted clinical decision support may enhance student learning, diagnostic confidence, and preparedness for practice. Effective integration requires staff and student training, clear governance, and critical awareness of AI limitations.

Despite its promise, AI should not be viewed as a neutral or universally accessible solution. Poorly designed or inadequately validated systems may reproduce existing inequalities, particularly if datasets are unrepresentative or technologies are inaccessible to disadvantaged groups. Ethical concerns relating to data privacy, transparency, accountability, and clinician overreliance must also be addressed.

AI in dentistry should therefore be implemented as an adjunct to professional judgement, not a replacement for human-centred care. Equity, inclusivity, patient safety, and educational preparedness should be central to future AI adoption.

Healthcare Workforce Shortages in High-Income Countries: Implications for Oral Healthcare Access and Inequalities

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Abstract

Healthcare workforce shortages are an increasing challenge across high-income countries, affecting service capacity, timely access to care, and the sustainability of healthcare systems. Dentistry and oral healthcare are not exempt from these pressures, particularly where shortages of dental professionals, uneven workforce distribution, and rising patient demand contribute to delayed care and widening oral health inequalities.

This evidence-based review explores the implications of healthcare workforce shortages for oral healthcare access, equity, and service delivery in high-income countries. The review draws on current literature examining workforce pressures, access barriers, professional retention, skill mix, and the impact of service shortages on vulnerable populations. Evidence suggests that workforce shortages can reduce appointment availability, increase waiting times, limit preventive care, and place greater pressure on already stretched services. These challenges may disproportionately affect underserved communities, including low-income groups, rural populations, older adults, and individuals with complex health or social needs.

The findings highlight that workforce shortages are not only a staffing issue but also an equity issue. In oral healthcare, limited workforce capacity may contribute to delayed diagnosis, increased emergency attendance, poorer continuity of care, and preventable disease progression. Potential responses include improved workforce planning, greater investment in prevention, wider use of dental care professionals, integration of oral health into wider healthcare pathways, and targeted strategies to improve recruitment and retention in underserved areas.

Addressing workforce shortages in oral healthcare requires system-level action that considers access, prevention, workforce wellbeing, and health inequalities together. Future research should examine how workforce models, digital innovation, and multidisciplinary approaches can improve oral healthcare delivery while ensuring that vulnerable populations are not further disadvantaged.

Reported inappropriate antibiotic prescriptions in dentistry: A Systematic Review.

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Abstract

Aim

Dentists prescribe an estimated 10% of all antibiotics used in humans. Inappropriate antibiotic use drives antimicrobial resistance; although some studies indicate that up to 80% of dental antibiotics in the USA and the UK are used inappropriately, the extent to which this is the case globally is unknown. Hence, we aimed to estimate the magnitude of reported inappropriate antibiotic prescribing (IAP) in dentistry.

Methods

Standard systematic review methodology was followed using the key concepts of antibiotics, misuse, and dentistry; the protocol was registered in PROSPERO. MEDLINE, EMBASE, Cochrane Library, Cumulative Index to Nursing and Allied Health Literature Plus (CINAHL), and Web of Science databases were searched. The Mixed Method Appraisal tool assessed study quality, and a narrative synthesis was conducted.

Results

21 studies met the inclusion criteria. The prevalence of reported IAP[CC2] [DC3] was high, with a mean of 64.03% and a median of 77.66% (IQR: 51.69% to 86.90%). Middle-income countries experienced the highest burden (mean 85.67%; median of 87.51%), followed by High-income countries (mean 53.25%; median 63.52%). No studies were identified from Low-income countries.

Conclusion

Strengthening stewardship, tailoring guidelines and interprofessional collaboration will support responsible prescribing. Future research needs to be prioritised to understand challenges and develop effective interventions.

Antimicrobial Activity of Omani Frankincense Against Endodontic Pathogens

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Abstract

Aim

Increasing concerns regarding antimicrobial resistance have encouraged the investigation of natural adjuncts to conventional intracanal antimicrobials in regenerative endodontics. This study aimed to investigate the antimicrobial activity of Omani frankincense extracts (OFE) against common endodontic pathogens, *Enterococcus faecalis* and *Fusobacterium nucleatum*, in comparison to double antibiotic paste (DAP), for potential use as an intracanal medicament in regenerative endodontics.

Methods

OFE was dissolved in ethanol containing 10% DMSO and diluted with fresh brain heart infusion (BHI) broth to concentrations of 25, 50 and 100 µg/mL. Standardised bacterial suspensions of *E. faecalis* and *F. nucleatum* ($OD_{600} = 0.0125$) were incubated in BHI broth at 37°C under aerobic and anaerobic conditions and exposed to OFE at inoculation. Bacterial growth was assessed by optical density (OD_{600}) and viable count (CFU/mL). Untreated cultures, solvent controls (DMSO+ethanol) and DAP served as controls. Experiments were performed in triplicate, and mean values were analysed using two-way ANOVA followed by Tukey's multiple comparisons test.

Results

Frankincense exhibited limited, transient antibacterial activity against both species. At 4 h, *E. faecalis* counts ranged from 7.00×10^6 to 2.81×10^7 CFU/mL compared with 2.69×10^9 CFU/mL in the solvent control, while *F. nucleatum* at 4 h, counts remained around 2.12×10^6 – 2.82×10^6 CFU/mL. However, at 24 h, bacterial counts increased to near-control levels for both species in treated groups. In contrast, DAP showed clear antibacterial activity, reducing counts to 4.06×10^3 CFU/mL for *E. faecalis* and 0 CFU/mL for *F. nucleatum* at 24 h.

Conclusion

Frankincense exhibited limited, dose-dependent, transient antibacterial activity against common endodontic pathogens, with inferior efficacy compared to DAP. Further investigations are ongoing to evaluate higher concentrations and explore potential synergistic effects with other compounds.

Development of calcium silicate scaffolds for regenerative endodontic therapy

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Abstract

Background: In regenerative endodontic therapy, the blood clot is used as a scaffold to allow the stem cells to grow and differentiate. This has some limitations such as rapid degradation and lack of control over porous architecture that compromise the regeneration outcomes. To overcome these limitations, a 3D printed scaffold with bespoke structure and porosity has been developed. This study explores an indirect printing approach using sacrificial moulds for scaffold fabrication incorporating a high loading of bioactive cement. **Aim:** To evaluate the feasibility of fabricating cement-based scaffolds using SLA-printed sacrificial moulds. **Methods:** Sacrificial moulds for scaffolds utilising a specific geometry with different wall thicknesses (0.6, 0.7, and 0.8 mm) and cell sizes (2, 2.25, and 2.5 mm) were designed and fabricated using SLA-based printing. Different printing orientations with and without support structures were evaluated using isopropyl alcohol (IPA) infiltration to assess mould patency. Preliminary scaffold fabrication was performed using cement and plasticiser to evaluate the ability to create the specific detail of the geometry being proposed. Following hydration of the samples, the injected moulds were subjected to thermal treatment up to 1100°C. The resulting scaffold was evaluated using micro-CT to assess scaffold integrity. **Results:** Moulds printed without tilted orientation and support structures showed internal blockage and failed fluid penetration, whereas tilted moulds with support structures improved mould patency. During scaffold fabrication, moulds with 0.6 mm wall thickness showed incomplete structure formation after cement infiltration, whereas 0.7 and 0.8 mm moulds preserved the scaffold architecture. Micro-CT analysis also revealed air entrapment and fragile structures after sintering. **Conclusion:** The findings suggest that indirect SLA-based printing is a promising approach for fabricating cement-based scaffolds for regenerative endodontic therapy. However, further optimisation of fabrication parameters is still required to improve scaffold integrity and reduce air entrapment.

Keywords: Regenerative endodontics; scaffold; SLA printing; sacrificial mould.

Accuracy of Digital Approaches in Tooth Surface Wear Measurement: A Comparative Study of Micro-CT, Prime Scan, and Lab Scanner.

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Abstract

Introduction:

The global prevalence of tooth wear in the general population is currently ~40% (Salari et al 2026). Accurate assessment of tooth wear is essential for diagnosis, monitoring, and treatment planning. However, in situ measurements have their challenges. Laboratory investigations using chewing simulators are used to replicate clinical tooth wear and examine tooth-material interactions. In such experiments, micro-computed tomography (micro-CT) is widely regarded as the gold standard for measuring wear due to its high resolution and precision, although its clinical applicability is limited. This limitation on replicating clinical tooth wear chairside has prompted an interest in digital scanning systems, with both extra-oral (e.g. InEos-X5, Dentsply Sirona) and intra-oral (e.g. Primescan, Dentsply Sirona) scanners emerging as potential alternatives. This study aims to evaluate whether these scanners produce comparable and reliable measurements relative to micro-CT.

Methods:

Five paired 3D-printed worn tooth samples were analysed using micro-CT, InEos-X5 lab scanner, and a Primescan intra oral scanner. Wear means were calculated for each method as was the coefficient of variation (CV) for each scanning method.

Results:

Wear volume change means were $-0.8269\text{mm}^3(\pm 0.1056)$ for micro-CT, $-0.8809\text{mm}^3(\pm 0.0427)$ for InEos-X5, and $-0.8172\text{mm}^3(\pm 0.0486)$ for Primescan, indicating no statistically significant differences using ANOVA ($p=0.094$) compared with micro-CT, suggesting a good agreement. Primescan and InEos demonstrated low variability of measurements (CV: 5.95% and 4.75%, respectively), while micro-CT showed greater variability (12.77%).

Conclusion:

Both scanners produce measurements comparable to the micro-CT benchmark, with low variability measurements between repeated scans. These findings support the potential use of digital scanning systems as a clinically viable chairside alternative for tooth wear analysis.

“Clinically confident or clinically competent?” A study of final year students’ self-assessments

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Abstract

Background

The University of Manchester Dental School introduced the Complete Assessment Feedback System (CAFS) in October 2024. This online system allows dental (BDS) and dental hygiene and therapy (BSc) students to record their clinical experience and grade their performance on a six-point scale, which is sent to their tutor for feedback.

Aims and Objectives

The primary aim was to evaluate how accurately students graded themselves when compared with tutor-given grades.

The secondary objectives were:

1. To assess differences in self-grading accuracy between students studying dentistry and dental hygiene and therapy.
2. To assess if there was a difference in grading accuracy between different clinical environments.

Methods

Retrospective data collection of final year BDS and BSc students’ grades on paediatric clinics in the Dental School and Outreach placement between October-December 2024, April-June 2025 and October-December 2025. Data gathered included the number of treatment sessions, self-given grades and grades from their tutor.

Results

Across all three data-collection periods, BDS students consistently overmarked their treatment quality in the dental school (17.54%, 21.78%, 21.91%). On outreach, their self-assessment of treatment quality aligned more closely with tutor grades, although overmarking increased over time (1.96%, 4.85%, 12.90%).

Contrastingly, BSc students overmarked their professionalism and attitude in the dental school during the first two periods (26.92%, 29.41%). In contrast, on outreach they undermarked these domains (42.86%, 14.29%). In the final period, BSc students overmarked treatment quality in the dental school (18.97%) and undermarked patient feedback/communication on outreach (5.17%).

Conclusion

To register with the General Dental Council, students must demonstrate safe beginner status, evidenced by clinical assessments. Accurate self-reflection helps students understand their competence, learn effectively, and become reflective clinicians. This study highlights the need to improve education of students in marking their knowledge and treatment on clinics and standardisation of clinical tutors.

Real-Time Silver Ion Release from Nano-Silver-Treated Hydroxyapatite

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Abstract

Silver-based cariostatic agents such as silver diamine fluoride (SDF) and silver nitrate are effective in arresting dental caries but are associated with undesirable black staining. Silver nanoparticles (AgNPs) have emerged as a potential alternative because of their high surface-area-to-volume ratio, antimicrobial activity, and reduced aesthetic impact. Previous in-vitro studies using hydroxyapatite (HAp) show that non-water-soluble AgNP-inks reduce calcium loss under caries-like conditions. However, the time-release rate and pH-dependency silver ion (Ag^+) release from these AgNP-inks remain unclear.

Objectives: This study investigated the real-time release of Ag^+ from AgNP-treated HAp discs under cariogenic and neutral pH conditions using ion-selective electrodes (ISEs).

Methods: HAp discs were immersed in 40 mL acetic acid solution (pH 4.0) at 37 °C for 2h to establish baseline demineralisation. Discs were then treated with AgNP (Nano-Silver Ink, Sigma-Aldrich) for 1 min and re-immersed in the solution for a further 2h. Ag^+ activity was continuously monitored using Ag^+ ISEs (NICO2000). Control experiments were performed in deionised water at pH 7.0.

Results: Under acidic conditions (pH 4.0), AgNP-treated discs demonstrated a sustained and approximately linear increase in Ag^+ release over time. In contrast, negligible Ag^+ release was observed at neutral pH (pH 7.0). These findings indicate that nano-silver ink exhibits a pH-responsive behaviour, preferentially releasing silver ions in acidic environments associated with active caries.

Conclusions: Within the limitations of this in vitro study, AgNP demonstrated a “smart” acid-activated ion release profile, suggesting potential as a minimally invasive cariostatic material capable of targeted antimicrobial activity under cariogenic conditions while minimising unnecessary silver exposure at neutral pH.

Evaluating an adapted empathetic-refutational interview (ERI) communication training package for dental teams on Human Papillomavirus vaccination: A feasibility study

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Abstract

Background

Human papillomavirus (HPV) is a leading cause of oropharyngeal cancers, and vaccination is an effective preventive strategy. Despite this, vaccine uptake remains suboptimal. Dental professionals are well placed to support HPV-related cancer prevention through routine patient contact; however, many report low confidence and limited or no training in discussing vaccinations. The Empathetic Refutational Interview (ERI), developed by the JITSUVAX programme, is an evidence-based communication approach designed to address vaccine hesitancy while maintaining trust. Its application within dental settings has not yet been explored.

Aim

To evaluate the feasibility and acceptability of delivering ERI-based HPV vaccine communication training through the existing JITSUVAX training provider to dental teams, and to explore preliminary changes in participants' confidence, knowledge, and comfort when discussing HPV vaccination.

Methods

This is a pre-post pilot feasibility study involving up to 20 General Dental Council-registered dental team members. Participants will attend an existing one-day, in-person ERI training workshop that has been tailored to HPV communication in dental contexts. Data will be collected through anonymous online questionnaires administered immediately before and after training. Quantitative measures will include self-reported confidence, knowledge, and comfort in HPV vaccine discussions. Descriptive statistics and paired comparisons will be used to explore pre-post changes. Free-text responses will undergo content analysis to identify key themes relating to acceptability and perceived usefulness.

Results

Data collection is scheduled for July 2026. Findings will report on feasibility outcomes (recruitment, participation, completion rates), acceptability, and preliminary indications of change in communication-related outcomes.

Conclusion

This study will provide early evidence on the feasibility of adapting ERI communication training for dental teams. Findings will inform refinement of the intervention and the design of a future larger-scale study, with the potential to enhance the role of dental professionals in HPV cancer prevention.

Scan-to-Simulation Fidelity in Haptic Dental VR

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Abstract

Haptic virtual reality (VR) simulators are increasingly used in preclinical dental education, yet the anatomical fidelity of underlying virtual models is rarely characterised. No validated protocol exists for integrating patient-derived scan data into haptic simulation workflows, and the pipeline stages at which geometric accuracy is lost remain uncharacterised. This study develops and evaluates a standardised digital pipeline for transferring tooth morphology acquired via micro-CT and intraoral scanning (IOS) into a haptic VR environment, quantifying accuracy at each discrete stage.

Extracted permanent molars were digitised using the MuCAT 2 micro-CT scanner (Queen Mary University of London; 90 kV, 15 μm voxel resolution), serving as the dimensional ground truth, and a DEXIS IS 3800 intraoral scanner for external crown geometry. Meshes were imported into the Simodont Dental Trainer and assessed at four pipeline stages using iterative closest point registration. Metrics included root mean square deviation (RMSD) and 95th percentile Hausdorff distance, contextualised against the operative tactile discrimination threshold (30–80 μm).

Cumulative RMSD increased progressively: $\sim 8\ \mu\text{m}$ post-mesh simplification, $\sim 18\ \mu\text{m}$ post-import, and $\sim 25\ \mu\text{m}$ within the rendered Simodont scene. End-point deviation was substantially higher for the DEXIS IS 3800 pipeline (RMSD $\sim 58\ \mu\text{m}$; H95 $\sim 120\ \mu\text{m}$) than the MuCAT 2 pipeline (RMSD $\sim 22\ \mu\text{m}$; H95 $\sim 48\ \mu\text{m}$). IOS deviation was greatest at occlusal fissures, cusp tips and cervical margins. Critically, end-point deviations from both pipelines exceeded the operative tactile discrimination threshold, suggesting pipeline-introduced error may be perceptible to the operator.

This is the first stage-resolved accuracy evaluation of micro-CT and IOS-to-haptic pipelines in dental education. Cumulative pipeline error within the Simodont environment can exceed tactile discrimination thresholds, with direct implications for haptic skill transfer validity. Stage-resolved fidelity benchmarks are a prerequisite for evidence-based simulation design and anatomically controlled preclinical assessment.

Effect of Marker Size Combinations on the Accuracy of Intraoral Photogrammetry for Complete-Arch Implant Scans: An In-Vitro Study

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Abstract

Objectives

This in-vitro study aimed to evaluate the trueness of complete-arch implant scans obtained using different Intraoral Photogrammetry (IPG) marker size configurations in a fully edentulous mandibular model.

Materials and Methods

A fully edentulous mandibular model with four implants placed in an All-on-4 configuration was used. Six marker size configurations were evaluated. A high-accuracy desktop scanner was used to obtain the reference scan. IPG scans were performed using the Aoralscan Elite intraoral scanner (Shining 3D Technology Co., Ltd., Hangzhou, China). Marker distribution varied between lateral and premolar implant positions using short, medium, and long coded markers. A total of 180 scans were obtained (n = 30 per group) and exported as STL files. Trueness was evaluated using root mean square (RMS) deviation values. Statistical analysis is currently ongoing.

Results

Preliminary observations demonstrated differences in trueness among the tested marker size configurations. Groups incorporating short and medium marker combinations appeared to demonstrate lower RMS deviations and more favourable trueness outcomes, whereas configurations involving larger markers tended to show increased deviations. Further statistical analysis is ongoing to validate these findings and determine their clinical significance.

Conclusions

Marker size configuration appears to influence the trueness of intraoral photogrammetry scans for complete-arch implant impressions. Configurations incorporating short and medium markers demonstrated more favourable accuracy outcomes than larger marker configurations. Further analysis is ongoing to validate these findings and assess their clinical significance.

Candidalysin gene expression: an in vitro study in *Candida albicans*

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Abstract

Background:

Candida albicans (*C. albicans*) is an opportunistic fungal pathogen associated with oral candidiasis. Its virulence is linked to hyphal growth, biofilm formation, and expression of Extent of Cell Elongation 1 (ECE1), which encodes the precursor of candidalysin, a hypha associated peptide toxin involved in epithelial damage. The influence of oral antimicrobial agents on ECE1 expression remains unclear.

Aim:

To investigate the effect of culture medium, growth state, and antimicrobial exposure on ECE1 expression in *C. albicans*.

Methods:

A targeted transcriptomic analysis was performed using ribonucleic acid sequencing data from *C. albicans* grown as planktonic cultures or 24-hour biofilms. Samples were cultured in Sabouraud dextrose medium and Roswell Park Memorial Institute 1640 medium, and exposed to chlorhexidine diacetate or nystatin, alongside untreated controls. Gene-level count data were analysed with a focus on ECE1. Model-based comparisons assessed the effects of medium, growth state, and treatment. P-values were adjusted using false discovery rate correction.

Results:

Culture medium was the dominant determinant of ECE1 expression. Roswell Park Memorial Institute 1640 medium induced higher ECE1 expression than Sabouraud dextrose medium, with a 105.7-fold increase. Biofilm growth showed a non-significant trend towards higher expression than planktonic growth. Overall antimicrobial treatment did not significantly alter ECE1 expression. Nystatin showed a trend towards reduced ECE1 expression compared with chlorhexidine in biofilm Roswell Park Memorial Institute 1640 conditions, but this was not statistically significant.

Conclusion:

These findings indicate that ECE1 expression in *C. albicans* is highly dependent on the experimental environment. The culture medium appears to shape the candidalysin associated transcriptional response more strongly than growth state or antimicrobial exposure. Although biofilm growth and nystatin exposure showed potentially relevant trends, these effects were not statistically significant in the present dataset. These findings highlight the importance of model selection when assessing candidalysin-associated virulence responses in oral *Candida* research.

Can silver diamine fluoride reduce negative impacts for young children with dental caries awaiting treatment under general anaesthesia: a feasibility study

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Abstract

Background

Thousands of children require dental extractions under general anaesthesia (DGA) due to caries. Waiting lists can be lengthy with many children experiencing pain and infection. Silver diamine fluoride (SDF) is a minimally invasive treatment to arrest caries. It may be useful to halt caries progression and therefore reduce pain and infection while children await DGA. Assessing the feasibility of conducting a trial to assess this is required.

Aim

To address key uncertainties to inform a larger randomised controlled trial of the effect of SDF on pain and infection for children awaiting DGA.

Methods

30 child/parent dyads were recruited across three sites in the UK. Children were aged 1-8 years and awaiting DGA for carious primary teeth. SDF was offered and applied when children were placed on a DGA waiting list. Data collected included: recruitment rate, retention rate, acceptance of SDF and incidence of pain or infection. Data analysis was simple descriptive statistics.

Results

30 children (100%) were recruited meeting target. Recruitment times to target were: 28 -76 days. The mean age was 5.2 years (range 3-8). The median dmft was 10 (range 4-19) and n=23 (93%) children were eligible for free school meals. Most children accepted SDF treatment (n=25 (83%)). The mean wait from recruitment to DGA was 69 days. Questionnaires were completed between recruitment and DGA for 33% (n=11). DGA data were available for n=23 (77%), this was retrospective for n=10 (43%), and prospective for n=13 (56%). At DGA there was report of pain and/or infection for n=8 (35%) children.

Conclusion

It was possible to recruit to this study in a timely fashion, however collection of prospective follow up data was challenging. For this high caries rate group, requiring dental GA, the majority could co-operate with SDF treatment but many still suffered from pain or infection.

THE IMPACT OF GLUCOSE UPTAKE ON PERIODONTAL CELLS

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Abstract

Introduction:

Diabetes mellitus is a chronic disease characterised by hyperglycaemia. The global prevalence of diabetes has reached epidemic levels, with more than one in ten individuals affected in 2021. It is strongly associated with increased prevalence and severity of periodontitis often referred to as the “sixth complication” of diabetes. This relationship is bidirectional, with poor glycaemic control resulting in increased periodontal disease severity.

The aim of this study was to investigate glucose uptake by oral keratinocytes and fibroblasts and assess the effect of physiological and diabetic glucose concentrations on cell viability, proliferation and growth.

Methods: oral epithelial cells (H400) and connective tissue fibroblasts (3T3) were exposed to glucose concentrations spanning physiological and hyperglycaemic ranges (0, 5, 10, 17, 25, 33 mM). Cell growth, proliferation and viability were assessed using the CCK8 assay and glucose was measured using glucometer for 10.

Results: H400 and 3T3 proliferation showed differences between physiological and diabetic glucose concentrations. For H400, under physiological glucose conditions (5 mM), cells remained viable for only 3 days, whereas 10 mM glucose supported growth for up to 7 days. This was confirmed by CCK-8 assays, which demonstrated a marked decline in absorbances after glucose depletion below 1.1 mM. In contrast, hyperglycaemic conditions (17–33 mM) maintained H400 cell viability throughout the 10-day period. For 3T3, physiological glucose concentrations (5 and 10 mM) failed to sustain cell survival beyond 2 days, with CCK-8 absorbances declining significantly by day 3. However, under diabetic glucose conditions (17, 25, and 33 mM), 3T3 cells showed a dose-dependent increase in proliferation over time. Notably, both H400 and 3T3 cells exhibited rapid cell death in zero glucose conditions.

Conclusion. Our findings highlight the impact of glucose on proliferation of cells and metabolic turnover which could potentially contribute to inflammatory responses associated with the pathogenesis of periodontitis.

Notch Signalling: A critical gatekeeper of periodontal homeostasis under pathological conditions

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Abstract

Introduction: Periodontal diseases result from host immune responses to the oral microbiota, beginning as gingivitis and progressing to periodontitis, characterised by periodontal tissue destruction and granulation tissue formation. The Notch signalling pathway is a key regulator of stem cell fate, tissue repair, and regeneration, yet its role in periodontal health and disease remains poorly understood. Recently, our group identified a granulation tissue-specific cell population with high Notch expression. This study investigated the role of Notch signalling in the periodontium using in vivo models.

Methods: Male and female 6-week-old CD1 mice underwent periodontal disease induction via ligature placement or oral gavage with *P. gingivalis* W50. Animals received daily intraperitoneal injections of either the gamma secretase inhibitor LY411/575 (10mg/kg) or vehicle for 7 days. Healthy controls received injections without disease induction. Samples were analysed using micro-CT imaging (Bruker SKYSCAN 1172; 15 µm resolution). Alveolar bone loss was quantified by measuring the alveolar bone crest–cemento–enamel junction (ABC–CEJ) distance at six sites per tooth. Statistical analysis used unpaired t-tests with significance set at $p < 0.05$.

Results: In healthy controls, LY411/575 treatment caused no significant change in ABC–CEJ distances compared with vehicle controls ($p = 0.1868$). Ligature-induced disease significantly increased bone loss compared with controls ($p < 0.0001$). Importantly, ligated mice treated with LY411/575 exhibited significantly greater alveolar bone loss than ligature alone ($p = 0.0052$). Using a novel oral gavage-induced gingivitis model, mice treated with LY411/575 developed early periodontitis with significant bone loss ($p = 0.0022$), whereas gingivitis alone produced no significant bone changes compared to controls ($p = 0.2191$).

Discussion & Conclusion: These findings demonstrate that Notch inhibition exacerbates periodontal bone loss during disease but not in health, suggesting a protective role for Notch signalling under pathological conditions. Our results indicate that Notch may regulate the gingivitis-to-periodontitis transition and support tissue repair, highlighting it as a promising therapeutic target for periodontal disease.

Effects of Sodium Bicarbonate on the Oral Microbiome

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Abstract

Sodium bicarbonate dentifrices improve clinical measures of gingivitis compared with regular fluoride dentifrices, even without professional prophylaxis, but their effects on the plaque microbiome are unknown. This 12-week study evaluated microbiome effects of a sodium bicarbonate and regular fluoride dentifrice in subjects with localised gingivitis.

In this randomised, controlled, examiner-blind, single-centre study, eligible participants with mild to moderate gingivitis (10-30% bleeding sites, Turesky Plaque Index >1.5) were enrolled without receiving a baseline oral prophylaxis and brushed twice daily with either a dentifrice containing 67% sodium bicarbonate or sodium fluoride. Supra- and subgingival plaque samples were collected at baseline and after 12 weeks, and metagenomic profiling was performed.

A total of 60 subjects completed the study. No statistically significant differences in microbial composition were observed between supra- and subgingival plaque samples at either timepoint; therefore, samples from both sites were combined for all subsequent analyses. Longitudinal analysis revealed statistically significant differences in beta diversity between baseline and week 12 for the test and control product ($p=0.001$ and $p=0.004$, PERMANOVA, respectively), indicating an overall change in the plaque microbiome over the study period. Furthermore, results demonstrated statistically significant differences in bacterial community structure between the test and control product ($p=0.001$, PERMANOVA). The relative abundance of *Granulicatella* and *Abiotrophia* was significantly higher in test group compared to control, while higher relative abundances of *Aggregatibacter*, *Selenomonas* and *Haemophilus* were observed in the control group (FDR-adjusted $p<0.05$, DESeq2).

Brushing twice a day with a 67% sodium bicarbonate dentifrice was associated with microbiome changes consistent with maintenance of a less mature, more health-associated plaque microbiome community. These findings provide novel mechanistic insight into how sodium bicarbonate dentifrices modulate oral ecology through physical plaque removal and support the association between health-associated microbiome shifts and previously demonstrated improvements in plaque control, gingival bleeding, and overall gum health.

Design and Evaluation of Additively Manufactured Gyroid-Infilled Healing Abutments for Local Chlorhexidine Delivery

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Abstract

Peri-implant diseases are the main factors resulting in dental implant failure. Local drug delivery from healing abutments may offer a potential route for delivering antimicrobial agents at the peri-implant soft tissue interface. This study aimed to develop additively manufactured healing abutment prototypes with different internal reservoir designs containing chlorhexidine-loaded xanthan gel (XCG) and to assess the release profile of chlorhexidine (CHX).

CHX release from XCG was characterised in static phosphate-buffered saline (PBS) using a microcuvette with a 10 mm optical path length. CHX absorbance was monitored at 254 nm at 4 and 9 mm. Three gyroid-infilled healing abutment CAD models with radial unit cell numbers of 4, 6, and 8 were generated using nTop software. The microcuvette release data were used to define the gel domain in computational fluid dynamics (CFD) simulations in Ansys Fluent R2024. Each abutment design was placed within a computational domain representing a stirred glass tube at 200 rpm. CHX transport was simulated using a species-transport model, and release profiles were compared between designs. The design showing the longest predicted CHX release was printed from Permanent Crown Resin using a Form 3B stereolithography printer. Experimental validation was performed by loading each printed abutment with 40 mg of XCG and immersing it in stirred PBS at 37 °C. UV–Vis spectroscopy was used to assess CHX release for 96 h by monitoring the 254 nm peak.

Microcuvette testing showed higher peak absorbance at P1 than P2 (1.097 ± 0.044 vs 0.256 ± 0.008 ; $p = 0.015$). Preliminary CFD results indicated design-dependent differences in predicted CHX release duration. Experimental validation showed cumulative CHX release of 20 mg/mL over 72 h.

Gyroid reservoir structures show promise as a suitable architecture for controlled local drug delivery, with potential applications in the prevention and treatment of peri-implant diseases.

Real-Time ISE Study of the Mechanisms of Action of SDF: Ca^{2+} , Ag^+ , and F^- Release During Caries-Like Acidic Demineralisation

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Abstract

Silver diammine fluoride (SDF) is a cariostatic agent with antimicrobial activity from silver ions, and demineralisation inhibition from fluoride ions. Despite evidence supporting SDF's efficacy, the aetiology of its protective mechanisms remains obscure.

Objectives: To compare real-time release rates of calcium, silver, and fluoride ions using ion-selective electrodes (ISEs) during demineralisation of hydroxyapatite (HAp) discs following SDF application, compared with when a similar amount of SDF is added directly to the demineralisation solution.

Materials and Methods: Nine HAp permeable (20%) discs (used as enamel analogues) were immersed in 1.0 mol/L acetic acid solution (pH=4.0) at 37.0°C. Ca^{2+} , Ag^+ , and F^- ISEs were used to measure each ion activity every 30s for 1h. The discs were treated with SDF (Riva Star, Australia) as per the manufacturer's instructions, for 1 min, then reintroduced into the demineralisation solution, and ion activities were similarly monitored for a further 4h. For comparison, each ion activity was similarly monitored before and after an identical volume of SDF was added directly into the demineralization solution (with the HAp disc present).

Results: SDF Applied: Baseline demineralisation showed a linear with time increase in Ca^{2+} activity, confirming HAp mineral loss prior to SDF application. Following SDF application, there was a linear with time increase in Ca^{2+} activity, and Ca^{2+} release rate reduced by 58.5 (± 1.2)%; Ag^+ activity increased immediately, followed by a gradual decline. F^- activity increased rapidly, then stabilized, indicating long-term availability.

SDF Addition: Baseline demineralisation showed Ca^{2+} activity increase. Following SDF addition; Ca^{2+} activity dropped rapidly, then a linear with time increase, and Ca^{2+} release rate reduced by 46.5 (± 9)%; Ag^+ activity increased immediately then gradually increased. F^- activity increased rapidly then decreased gradually, suggesting long-term precipitation.

Conclusion: During caries-like demineralisation, SDF reduces Ca^{2+} release; delivers antimicrobial Ag^+ ; and maintains F^- reservoirs for remineralisation.

Improving oral health care provision for children and young people in a residential special educational setting in Hertfordshire

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Abstract

Objectives:

Children and young people (CYP) with autism and/or a learning disability experience poorer oral health than the general population, including those in residential special educational settings (RSES). In 2023, NHS England published a clinical standard to guide oral health programmes in RSES. This project aimed to evaluate the initial implementation of an oral health programme delivered by Hertfordshire Special Care Dental Service in a RSES, compared to the clinical standard.

Methods:

A retrospective service evaluation was undertaken of oral healthcare provided to CYP aged 5–18 years between October 2025-May 2026. Data were collected on age, gender, ethnicity, clinical complexity, and existing access to dental care, alongside assessment of components outlined in the standard.

Results:

Face-to-face onsite oral health checks were offered to all CYP with valid parental consent. Thirty-seven CYP had consent for examination, of whom fifteen resided at the school for at least 38 weeks annually. Mean age was 14 years; 70% were male, 72% White British, with clinical complexity ranging from moderate to extreme. Two CYP had existing access to tertiary dental care.

89% of consented CYP co-operated for clinical assessment and received RAG-rated oral health risk assessments. Written summaries of oral health risk and preventive advice were shared with parents/carers and the school nursing team.

Tailored mouth care plans were co-designed with carers for 73% of residential pupils; the remainder received plans based on clinical assessment alone due to limited carer engagement. Follow-up clinic appointments were arranged for five CYP requiring further investigation/intervention.

Conclusions:

Initial implementation of the programme improved communication of oral health messages and delivery of care for CYP with complex needs and limited access to dental services. Further work is required to engage and train carers in supporting oral health for residential pupils.

Resilience – developing inner strength strategies and behaviours in undergraduate dental students.

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Abstract

Transitioning into life at university can be a challenging time for any new dental student, feeling overwhelmed and even anxious, particularly in relation to the practical 'settling in' aspects of university life. This transition is intensified for dental students due to high expectations of achievement throughout their 5-year course.

One key mechanism by which students can be helped is via the importance of educators supporting their students in several ways as they develop their resilience and adaptability skills i.e., role modelling positive behaviours, mindsets and attitudes, establishing trust, and respect. To enable these behaviours, Peninsula Dental School (PDS) engaged with Plymouth-based charity, Well Connected, and have created an inner strength/resilience-themed workshop for first year dental students.

The collaboration led to the creation of a workshop which enables students to explore the benefits of developing inner strength, adopting resilient thinking strategies and ways of working, which in turn impact positively on attitudes and behaviours on all aspects of their life.

The workshop is delivered during the induction sessions in the first two weeks of term; a pivotal time for undergraduates as they settle into life at university and understanding expectations of their academic and clinical studies. The session is interactive and combines group-based activities, roundtable discussions and guest speakers sharing their experiences of overcoming difficult and challenging experiences. Students are encouraged to consider various on-campus resources, the importance of their own creativity/adaptability, supporting one another, specific school resources and being 'present' within their own environments.

The result is sharing of knowledge and ideas to create a unique learning opportunity which engages undergraduates in an enjoyable and thought-provoking workshop which will continue to impact on them throughout their academic studies and personal development.

Navigating oral health outcomes in a birth cohort study

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Abstract

Background

The Children Growing Up in Liverpool (C-GULL) study is a longitudinal research platform committed to understanding non-communicable disease trajectories by focusing on the determinants of health in one of England's most disadvantaged cities. The inclusion of an oral health component, embedded from the outset, speaks to its potential to address gaps in the risk factors and common determinants of poor oral health in children.

Aim

To explore the range of possible uses of oral health related data generated by the C-GULL study.

Methods

Participant questionnaires are completed at five timepoints ranging from baseline (12 – 16 weeks gestational age) to age 2, with oral health questions included at four timepoints. An oral health assessment will be undertaken as part of the 2-year in-person assessment. The study also includes a digital cohort, thereby providing additional opportunities for data linkage. Analysis of oral health related birth cohort literature was undertaken to identify research priorities and explore the potential for data linkage. A map of data linkages specific to the C-GULL data was identified.

Results

Subject: Dental attendance (age of child's first dental visit); **Outcome:** Child caries experience age 2 (with potential to follow-up thereafter); **Data sources:** C-GULL Questionnaire data and C-GULL Oral health assessment.

Subject: Dietary patterns (sugar intake including soft drinks and fruit juices, and sweets, biscuits and snacks); **Outcome:** Child caries experience age 2 (with potential to follow-up thereafter); **Data sources:** C-GULL Questionnaire data and C-GULL Oral health assessment.

Subject: Fluoride exposure (child toothbrushing frequency); **Outcome:** Child caries experience age 2 (with potential to follow-up thereafter); **Data sources:** C-GULL Questionnaire data and C-GULL Oral health assessment.

Conclusion

The information gathered from the C-GULL study has enormous data linkage potential, enabling new insights into the determinants of poor oral health.

Going private? Analysing the supply and demand of private dental care in the UK

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Abstract

Background

Persistent challenges in NHS access alongside growth of private-only dental practices have raised concerns about "two-tier" oral healthcare, but robust evidence on the private sector is sparse. We aim to describe the supply and demand of UK private dental care.

Methods

We link NHS BSA contract data and Care Quality Commission practice registrations (2016-2026) to describe trends and predictors of private-only practice entry, using Poisson within-between regression. We analyse the UK Household Longitudinal Study (2018-2022) and NHS England Health Insights Survey (2024-2026) using multinomial logistic regression to identify individual-level predictors of private use, adjusting flexibly for covariates.

Results

Private-only practice numbers were stable until 2020, but by 2026 increased by 26% to 4980, representing 41% of all dental practices. Growth was concentrated in London, the South East and South West but extended across most regions, while NHS practice counts fell only in the North East and South West. Private only practices were located disproportionately in older, affluent, urban areas with higher NHS delivery per capita; declines in NHS activity over time with associated with modest private entry.

When analysing UKHLS data, predicted use of private care was highest among older adults (33% aged 75), postgraduates (28%) and the self-employed (25%) and increased with income. Private use remained stable post-Covid, but 36% of previous NHS users transitioned to no-use by 2022. By 2026, 36% of HIS respondents reported using a private dentist, of whom 29% did so because they could not access an NHS dentist.

Discussion

Private-only practices have risen in affluent and urban areas with higher NHS activity, and serve older, affluent users. The private market appears to be expanding in existing affluent markets rather than filling gaps in NHS access, though a substantial minority use it as a substitute for when unable to access NHS care.

The anti-inflammatory effects of curcumin in 2D and 3D oral epithelial models challenged with heat-killed periodontal bacteria.

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Abstract

Curcumin is a natural compound widely recognised for its anti-inflammatory properties. However, many *in vitro* studies investigated its effects in two-dimensional (2D) monolayer cultures, which might not fully represent the complexity of oral epithelial inflammatory responses. Three-dimensional (3D) air-liquid interface (ALI) models provide physiologically relevant *in vitro* tissue equivalents that mimic epithelial architecture and barrier function.

This study aimed to compare barrier function and inflammatory responses in oral epithelial cells cultured in 2D transwell monolayer and 3D ALI models following stimulation with heat-inactivated periodontal pathogens or lipopolysaccharide (LPS; positive control), and to investigate whether curcumin modulates these responses. Two head and neck squamous cell carcinoma cell lines (H460 and VU040T) were cultured as either 2D or 3D ALI models. Inflammatory conditions were induced using LPS or heat-killed bacterial suspensions, including *Porphyromonas gingivalis*, *Fusobacterium nucleatum* and *Streptococcus oralis*, at a multiplicity of infection (MOI) of 100:1. Cultures were investigated following either curcumin pre-incubation or vehicle (negative) control.

Barrier integrity was evaluated using transepithelial electrical resistance (TER), while pro-inflammatory cytokine production was assessed by enzyme-linked immunosorbent assay (ELISA). Gene expression changes were investigated using quantitative PCR (qPCR) and RNA sequencing to identify cellular responses specific to either culture model.

Exposure of cells to heat-killed bacteria showed a trend towards reduced barrier integrity and increased pro-inflammatory cytokine secretion in both 2D and 3D culture systems. Curcumin pre-incubation reduced IL-8/CXCL8 secretion, but produced an unexpected trend towards reduced barrier integrity and increased GM-CSF and TNF- α secretion. Transcriptomics and qPCR analyses further supported model-dependent differences in inflammatory gene expression.

Overall, these findings suggest that both inflammatory responses (cytokine and gene expression) and therapeutic effects of curcumin are influenced by the cell culture system. Specifically, the 3D ALI model may provide a more clinically relevant model system to evaluate potential anti-inflammatory compounds in periodontal disease research.

Constructing Support Needs in Dental Care: *Preliminary Findings from a Story Completion Study of Recognition, Legitimacy and Unequal Access*

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Abstract

Although equitable dental care for patients facing disability-related barriers is commonly framed through access, adjustments and person-centred care, unmet support needs continue to shape engagement and oral health outcomes. Informed by constructivism (Olsen & Pilsen, 2022), this study explores how support needs are constructed within dental care, and how this may shape access and oral health inequalities.

METHODS: Using an embedded mixed-methods design, adult patients, parents, carers and dental professionals were purposively recruited to complete an anonymous online story completion task. Participants continued a fictional dental appointment story in which support needs were not easily captured through standard paperwork. Reflexive thematic analysis explored how disclosure and recognition of support needs were constructed within story completions. A dental experience questionnaire provided contextual insights.

RESULTS: Preliminary analysis of 30 completions identified early patterns. Narratives praised dental professionals' empathy, yet positioned teams as gatekeepers of legitimate, actionable need. Support needs were individualised as patients' or supporters' responsibility to disclose, evidence and manage, creating anticipatory anxiety, emotional labour, advocacy burden and fear of stigma. Nine stories ended positively, four neutrally and seventeen negatively. Interactions turned on small relational practices: noticing, asking, listening, slowing down and making space. Positive/neutral endings remained conditional: eight relied on visible distress, performance of legitimacy, benevolence or institutional rationalisation; seven reproduced 'good-patient' norms through camouflaging politeness, compliance, endurance, and stoicism. One avoided conditional traces, imagined within special care dentistry. Negative endings escalated through misattunement, ruptured emotional safety and siloed documentation: ten described treatment disengagement; two imagined dysregulation escalating to police presence.

CONCLUSION: Findings suggest inequity may be reproduced when support needs must be made legitimate and actionable. Imagined equitable dental access required more than formally available reasonable adjustments, relying instead on anticipatory systems, relational recognition and parity of experience. Ongoing analysis will explore role-based dissonance between lived and recognised need.

Evaluating the gingival response to oral glucose in periodontitis

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Abstract

BACKGROUND

Despite the clear bidirectional relationship between glycaemic profile and periodontitis in people with diabetes, less is known about the association between glucose metabolism and periodontitis in systemically healthy individuals. This study sought to investigate whether the gingival responses to oral glucose differed between normoglycemic individuals with periodontitis and those with plaque-induced gingivitis, and whether this was reflected in the systemic circulation.

METHODS

Normoglycaemic patients (fasting plasma glucose 72-109 mg/dL and HbA1c <6.0%), aged over 18 years old, were recruited to a cross-sectional study at the Saint Leopold Mandic college (Campinas, Brazil) between July 2024 and November 2025 (CAAE 75924423.9.0000.5374). Gingival crevicular, peripheral capillary and venous blood samples were collected from 10 individuals with periodontitis, and 10 with plaque-induced gingivitis, following an oral glucose challenge (75g glucose in 250-300 mL water) at baseline (eight-hour fasting glucose), 30-, 60-, 90- and 120-minute intervals (an oral glucose tolerance test).

RESULTS

Participants with periodontitis displayed significantly different gingival crevicular glycaemic responses to those with plaque-induced gingivitis [group × time interaction: $F(3.24, 58.28) = 3.58$, $p = 0.017$, $\eta^2G = 0.086$]. Post hoc analysis attributed this difference to a significantly greater peak gingival glucose concentration at 30 minutes in the periodontitis group following the oral glucose challenge [estimated mean difference 37.5 mg/dL, 95% CI 7.1-67.9, $p = 0.018$]. No significant differences between the groups were observed in the peripheral capillary or venous blood responses.

CONCLUSION

Normoglycaemic individuals with periodontitis display altered local gingival glycaemic responses despite equivalent systemic glucose responses to controls. These findings suggest that periodontitis may be associated with locally dysregulated glucose handling, independent of systemic glycaemic control.

Effect of Glass Infiltration on the Biaxial Flexural Strength, Weibull Modulus, and XRD Characteristics of 5Y-PSZ Zirconia

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Abstract

The objective of this study was to analyze the effect of glass infiltration on the biaxial flexural strength, Weibull modulus, and X-ray diffraction characteristics of 5Y-PSZ zirconia. Discs were fabricated by uniaxial pressing of 5Y-PSZ (Zpex Smile, Tosoh, Japan) and 3Y-TZP (Zpex, Tosoh) powders under 3 tons for 30s. The 5Y-PSZ specimens were divided into two groups: with and without glass infiltration (n=32). For the infiltration group, specimens were pre-sintered (1450°C, 60min), followed by glass application on one surface and final sintering (1450°C, 120min). The non-infiltrated 5Y-PSZ and 3Y-TZP groups were sintered with 1450°C, 120min. After sintering, all specimens measured 12mm in diameter and 1.2mm in thickness. X-ray diffraction analysis (n=2) was performed to evaluate phase characteristics. Biaxial flexural strength was performed (n = 30; 1000kgf; 0.5 mm/min). Weibull modulus (m) and characteristic strength (σ_0 ; 95% CI) were calculated. Flexural strength data were analyzed using Welch's ANOVA and Games–Howell test ($\alpha=0.05$). Fractographic analysis and X-ray diffraction data were analyzed qualitatively. The infiltrated 5Y-PSZ zirconia exhibited flexural strength statistically similar to that of 3Y-TZP. 5Y-PSZ group showed a Weibull modulus of 7.47, statistically similar to that of infiltrated 5Y-PSZ (7.29). Infiltrated 5Y-PSZ presented a characteristic strength value of 1053.88 MPa (1000.69–1109.88), statistically similar to that of 3Y-TZP (1046.80 MPa; 982.01–1115.87). For all groups, fracture originated predominantly from the tensile surface beneath the loading area. Glass infiltration of 5Y-PSZ zirconia resulted in phase alteration, with characteristic tetragonal phase peaks. It can be concluded that glass infiltration significantly increased the biaxial flexural strength of 5Y-PSZ, raising its characteristic strength to levels comparable to those of 3Y-TZP without compromising material reliability. The presence of tetragonal phase peaks suggests microstructural modification associated with the infiltration process, indicating a potential influence on the mechanical response of the material.

Developing a Predictive Algorithm for Dental Caries in Saudi Arabia: A Life-Course Machine Learning Approach from Early Childhood to Adulthood

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Abstract

Dental caries remains a critical public health challenge in Saudi Arabia, affecting approximately 72.6% of preschool children and 86% of those with primary dentition. Despite this burden, validated clinical prediction tools tailored to the Saudi population remain absent. This proposal describes a prospective, longitudinal study to develop, validate, and deploy a machine-learning-based predictive algorithm for dental caries risk across the life course — from infancy to adulthood — in the Kingdom of Saudi Arabia (KSA).

The study will recruit two age-stratified cohorts (preschool: 3–5 years; early school: 6–8 years) from multiple regions of KSA, collecting baseline and follow-up data over 24 months. Predictors will encompass socioeconomic, dietary, oral hygiene, biological, microbiological, and environmental domains. Machine learning models — primarily Random Forest, Gradient-Boosted Decision Trees, and Support Vector Machines — will be trained using nested cross-validation and validated externally across geographically distinct populations. A SHAP-based explainable clinician interface will be deployed in a pilot phase at two clinical sites.

This research will produce a validated, equity-aware, bilingual (Arabic/English) clinical decision support tool capable of identifying high-risk individuals for early intervention, directly supporting Vision 2030 health prevention goals.

Effect of commercial cleaning agents on resin-zirconia bond strength

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Abstract

Purpose: To evaluate the effect of three commercial ceramic cleaning agents in restoring the micro-tensile bond strength (μ TBS) of resin cement to zirconia surfaces contaminated with saliva and silicone-disclosing agent.

Materials and methods: Sixteen zirconia blocks were randomly allocated into four groups. The control group remained uncontaminated, while the remaining three groups underwent surface contamination with saliva and silicone disclosing agent, followed by cleaning using one of three commercial cleaning agents: Ivoclean, Katana Cleaner, or ZirClean. Subsequently, all zirconia surfaces were applied with a universal primer (G-Multi Primer). The blocks in each group were bonded together with a resin cement (G-Cem Linkforce). The bonded zirconia blocks were sectioned under a water-cooled diamond saw, yielding microstick specimens with a cross-sectional area of 1 mm². Specimens from each group were subjected to either 24 h water storage or 10,000 thermocycles ($n = 10$ per subgroup) and performed μ TBS tests. Statistical analysis (SPSS software) was performed on μ TBS data ($\alpha = 0.05$).

Results: After 24 h of water storage, the control group exhibited the highest μ TBS values. Among the contaminated groups, ZirClean and Katana Cleaner demonstrated significantly higher bond strength than Ivoclean; however, all three cleaning-agent groups showed significantly lower bond strength than the control group. Thermocycling significantly reduced bond strength in all groups. Following aging, the control group maintained the highest μ TBS values, while ZirClean and Katana Cleaner groups continued to exhibit significantly higher bond strength than Ivoclean group.

Conclusions: Regardless of aging conditions, the use of commercial ceramic cleaning agents (Ivoclean, Katana Cleaner, and ZirClean) resulted in significantly lower bond strengths than the uncontaminated zirconia, with ZirClean and Katana Cleaner outperforming Ivoclean, suggesting differential cleaning potential among commercial cleaning agents.

Sealing Performance of Three Calcium-Silicate Materials in Endodontic Perforation Sites

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Abstract

OBJECTIVES: Root canal perforation requires durable sealing to prevent bacterial ingress and periodontal breakdown. This study compared the sealing efficiency of three calcium silicate-based perforation repair materials: MTA Angelus®, Biodentine™, and Well-Root™ Putty.

METHODS: Twenty-one (n=21) extracted molars were perforated at the furcation and buccal wall using a 1.6 mm diamond ball bur and randomly assigned to repair with one of the three materials (5 per pH subgroup). Specimens were scanned by MuCAT2 X-ray microtomography (XMT) at baseline, then immersed in acidic (pH 4) or neutral (pH 7) buffer at 37 °C for six months and rescanned. Ion release was assessed by ICP-OES, microstructural changes by SEM, and longitudinal weight stability quantified. Between-material comparisons used the Kruskal-Wallis test with Dunn's post-hoc.

RESULTS: At baseline, MTA had the smallest marginal gap (mean $0.65 \mu\text{m}^3$), significantly less than Well-Root Putty ($3.82 \mu\text{m}^3$; $p = 0.023$; overall $H = 7.598$, $p = 0.022$); MTA and Biodentine ($1.19 \mu\text{m}^3$) did not differ ($p = 1.000$). After pH 4 immersion, MTA showed the largest descriptive change (Δ marginal gap $+6.22 \mu\text{m}^3$; Δ void $+11.69 \mu\text{m}^3$); Biodentine had the smallest marginal gap ($1.67 \mu\text{m}^3$); and Well-Root Putty had the most stable void volume ($\Delta \leq +1.81 \mu\text{m}^3$). However, between-material differences at pH 4 did not reach statistical significance ($H = 5.024$, $p = 0.081$). Biodentine showed increased void volumes under both pH conditions and lost ~19% of its mass over six months, versus ~1.7% for Well-Root Putty. All materials released calcium and silicon ions throughout immersion.

CONCLUSIONS: Well-Root Putty showed the most consistent structural integrity and sealing across both pH environments and may be preferred for perforation repair where an acidic local environment is anticipated. Although MTA Angelus achieved the most effective initial seal, it showed the greatest descriptive susceptibility to acid degradation.

CAD/CAM FLUORMICA ENDOCROWNS

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Abstract

Objective: Balancing optimal machinability with sufficient mechanical strength and translucency remains a challenge for dental CAD/CAM materials. Low-boron barium fluormica glass-ceramics offer a potential solution due to their unique microstructure, which promotes excellent machinability and durability. This study evaluates the feasibility of developing a low-boron barium fluormica glass-ceramic with mechanical and optical properties suitable for CAD/CAM endocrown fabrication.

Methods: Parent glasses were prepared using the melt-quench technique from a pre-melted glass frit, followed by a two-step heat treatment through nucleation at 600 °C and crystal growth holds between 900 °C and 1100 °C to produce monolithic glass-ceramics. Thermal behaviour, crystallinity, and microstructure were characterised using differential scanning calorimetry (DSC), X-ray diffraction (XRD), magic-angle spinning nuclear magnetic resonance (MAS-NMR), and scanning electron microscopy (SEM). Key physical properties relevant to CAD/CAM applications were evaluated through UV-Vis spectrophotometry for translucency, Vickers microhardness testing, and a custom machinability test.

Results: DSC revealed a consistent glass transition temperature (T_g) around 660-680 °C. XRD and MAS-NMR confirmed progressive crystallisation and local structural ordering with increasing heat treatment, identifying kinoshitalite as the predominant crystalline phase at 1100 °C. SEM demonstrated a microstructural evolution from isolated, curved 'cabbage-head' colonies at 900-950 °C to an interlocking plate-like architecture at 1000 °C and above. Optical transmittance decreased as treatment temperatures increased, likely due to enhanced scattering from the developing crystalline network. Vickers microhardness ranged from 3.78 to 5.20 GPa, with the lowest hardness and cutting resistance observed in the 1000-1050 °C treatment group.

Conclusion: Low-boron barium fluormica glass-ceramics can be tailored through specific heat treatments to achieve a practical machinability window, particularly between 1000 °C and 1100 °C. By establishing a balance among machinability, hardness, and translucency, this material exhibits strong potential for CAD/CAM fabrication of dental endocrowns, warranting further clinical and mechanical validation.

Coaggregation between Oral Streptococcus and Actinomyces Group Species

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Abstract

Introduction

Dental plaque is a polymicrobial biofilm whose development depends on coaggregation mediated by specific adhesin–receptor interactions. Some of these interactions have been characterised in detail such as the adherence of *Streptococcus gordonii* DL1 to *Actinomyces oris* MG1 via *S. gordonii* SspB binding an *A. oris* carbohydrate receptor. Advances in genomics provide new opportunities to extend our understanding of coaggregation interactions and to identify new targets for controlling dental biofilms.

Aim

To identify novel coaggregation mechanisms between different species of oral streptococci and species of *Actinomyces* and *Schaalia*.

Methods

Selected bacterial strains were cultured anaerobically at 37 °C, washed, and adjusted to an OD₆₀₀ of 1.2. Equal volumes were mixed and assessed for coaggregation, which was visually scored (0–4) based on flocculation and sedimentation. Selected interactions were further analysed by phase contrast and confocal laser scanning microscopy.

Results

Oral streptococci demonstrated variable coaggregation behaviour with *Actinomyces* and *Schaalia* species. For example, strong coaggregation (score '4') was observed between *S. gordonii* DL1 or *S. intermedius* 40 with *Schaalia odontolytica* NU94 that was not inhibited by lactose. *Streptococcus oralis* 34 showed slightly weaker coaggregation (score '3') with *S. odontolytica* NU94 that was completely inhibited by lactose. *S. oralis* 34 coaggregated strongly with *Actinomyces naeslundii* 963VP1, *Actinomyces oris* C16, and *Actinomyces oris* MG1. In contrast, *Schaalia dentiphila* C24 showed no coaggregation with most streptococcal strains, except *Streptococcus oralis* NU39. Strong coaggregation was also observed between *Actinomyces oris* C16 or *Actinomyces oris* WVU626 with *Streptococcus oralis* subsp. *tigurinus* JP1BV1.

Conclusion

Oral streptococci exhibit distinct coaggregation behaviours with *Actinomyces* and *Schaalia* species. Some interactions were sensitive to lactose, indicating that they are dependent on lactose-sensitive lectin–carbohydrate binding, whereas others are not. Future work will aim to identify specific protein adhesins and carbohydrate receptors that mediate these networks of coaggregation interactions.

Assessing the Oral Health Impact of Nicotine Pouches: Early Insights from a Professional Survey

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Abstract

Objective: To understand dental professionals' insights and experiences of treating patients who use oral nicotine pouches.

Background: Nicotine pouches are tobacco-free products placed intra-orally, typically between the lip and labial mucosa, for nicotine delivery. There is currently limited evidence regarding their oral and dental effects, and awareness among dental professionals is limited.

Methods: A national survey was distributed to dental professionals to evaluate their clinical observations and perceptions of nicotine pouch use. Respondents were asked to report any oral findings observed in patients and provide their views on the potential risks associated with these products. An interim analysis was completed.

Results: At the time of interim analysis, a total of 124 responses were received, nearly one-half were from general dental practitioners, interestingly around one-fifth were from dental nurses. Almost half of respondents do not routinely ask patients if they use nicotine pouches either in person or on their medical history form. Commonly reported oral findings associated with nicotine pouch use included gingival recession, white patches, and ulceration. Regarding perceived risk, 38% of respondents considered nicotine pouches to be more harmful than e-cigarettes. One-third of respondents believed nicotine pouches were carcinogenic.

Conclusions: This interim analysis highlights potential oral manifestations associated with nicotine pouch use, alongside significant uncertainty among dental professionals regarding their safety. These findings emphasise the need for increased clinical awareness and further research to better inform patient management.

A host-microbial model of the oral mucosa to assess immune and metabolic interactions.

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Abstract

Objectives: The human oral microbiome functions synergistically with the oral mucosa to maintain barrier integrity and immune homeostasis. Changes in the oral microenvironment can alter microbial community composition, contributing to epithelial dysfunction and inflammation. This project aims to develop a microfluidic host-microbial model of the oral mucosa to investigate associations between microbial composition, inflammatory responses, and volatile organic compound (VOC) production.

Methods: An *in vitro* 10-species biofilm representative of the commensal oral mucosa was established. Biofilm composition was assessed using 16S rRNA sequencing and qPCR. A 3D organotypic oral mucosa model was generated in transwells using human oral keratinocyte and oral fibroblast cell lines. Cell survival was assessed with live-dead cell staining.

Results: 16S rRNA sequencing and qPCR confirmed the presence of all 10 bacterial species within the multispecies biofilm. Organotypic co-cultures of OKF-6 and NHO-7 cells were successfully maintained for 10 days at an air-liquid interface. Live-dead cell staining confirmed cell confluency and survival. These findings show successful establishment of the separate microbial and host components for integration into a host-microbial model.

Conclusions: A representative 10-species oral mucosal biofilm and organotypic oral mucosa model have been successfully established and characterised. Ongoing work employs immunohistochemical analysis to demonstrate epithelial cell differentiation and stratification. The project will integrate the host and microbial components within a microfluidic platform to investigate microbial-epithelial interactions, inflammatory responses, and VOC production. This model will provide a foundation for studying host-microbial interactions in oral health and disease.

Antibiotics don't cure toothache: can clinical audit reduce antibiotic prescribing in primary dental care in Thames Valley?

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Abstract

Background

Dentistry is responsible for about 7% of prescribed antibiotics in UK primary care. Studies indicate up to 80% are inappropriate. Engaging NHS dental practices in audit, although challenging, is demonstrated to be effective at reducing the amount and improving the appropriateness of antibiotic prescribing.

Aims

To investigate the extent to which a funded collaborative audit among NHS dentists, offering best practice antimicrobial stewardship education, could improve appropriate prescribing when treating patients presenting with toothache.

Methods

Study was classed ethically exempt by University of Manchester, No2025-22814-40252, 24th March 2025. Buckinghamshire, Oxfordshire and Berkshire west ICB recruited local NHS dentists to a collaborative audit by email. Participants consented to their anonymised data being collated, analysed and disseminated with remuneration at £390 per completed audit cycle. Self-reported data were collected using the UK Dental Antimicrobial Stewardship Toolkit self-audit tool before submission via a bespoke document. Baseline data were collected for a minimum of the first 20 patients treated for toothache in unscheduled appointments from April to August 2025. In October 2025 a verifiable CPD educational session was provided by a College of General Dentistry (CGDent) expert. Further data were collected, November 2025 and February 2026, with additional questions to elicit the experience of participating in the study. Before and after data were compared using descriptive statistics. Thresholds for compliance were set at >84% of prescriptions per dentist representing high compliance and <54% as low compliance in accordance with CGDent guidance.

Results

43 participants consented, 51% (n=22) completed both cycles. 52% (n=14/27) reported high compliance with guidelines before the intervention. while 30% (n=8/27) indicated moderate to low compliance. Following intervention, 73% (n=16/22) reported high compliance. 95% (n=21/22) reported their prescribing habits had changed between audit cycles.

Conclusion

The collaborative audit identified justified prescribing, but further work is needed to understand barriers to participation.

"It relies on the people": A multi-site case study of supervised toothbrushing programme implementation in England.

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Abstract

Objectives Supervised toothbrushing programmes (STPs) are a clinically and cost-effective public health intervention for reducing dental caries and oral health inequalities in children. In March 2025, the government pledged £11 million to expand STPs to 600,000 children living in England's most deprived areas. This study aimed to examine real-world implementation experiences across diverse STP delivery contexts, identifying key barriers and facilitators.

Methods A longitudinal multi-site case study was conducted across four purposively selected localities in England, representing varied commissioning arrangements, programme maturity, delivery models and uptake levels. Initial and follow-up interviews (n=27) were conducted with 14 stakeholders (commissioners and providers) before and after the government funding announcement. Data were analysed using framework analysis, guided by implementation science frameworks.

Results Two key barriers were identified across the four cases: 1) Infrastructure limitations which included three interconnected barriers (funding uncertainty, workforce capacity and logistical challenges around supply distribution) that undermined programme continuity and constrained programme expansion; 2) Engaging early years settings was also an evident challenge, barriers included structural capacity and attitudinal resistance from school leaders. Attitudinal barriers were shown to be responsive to trusted intermediaries who reframed STP as aligned with school readiness and child health agendas.

Two central facilitators emerged: 1) Strengthening relational infrastructure through relationship-building across local authorities, providers, health visiting teams and wider partners and 2) Knowledge sharing through national resources, local networks and peer-to-peer learning which improved capacity and programme scale-up.

Conclusions Funding is necessary but insufficient for sustainable STP delivery. Achieving national targets requires investment in relational infrastructure, stable workforce capacity and formal mechanisms for knowledge exchange. The distinction between structural and attitudinal barriers should be taken into consideration when designing engagement strategies.

Clinic-Informed Bayesian Optimisation of Maxillary Incisor Torque Control in Clear Aligner Therapy with In Vitro Biomechanical Validation

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Abstract

OBJECTIVES: To develop a clinic-informed, in vitro-validated Bayesian workflow for optimising clear aligner design for maxillary incisor torque control, a common clinical challenge in aligner therapy.

MATERIAL AND METHODS: A retrospective anonymised archive of clear aligner cases from a private dental clinic was reviewed to identify clinically relevant design challenges and parameter ranges for maxillary incisor torque control. A reproducible parametric finite-element model of a maxillary incisor, periodontal ligament and alveolar bone was generated using code-defined geometry. Seven aligner-related design variables were investigated, including attachment width, attachment height, attachment thickness, attachment cervical offset, aligner thickness, trimline extension and pressure-ridge height. A mechanistic load-transfer model was coupled with Gaussian-process Bayesian optimisation to identify candidate designs with improved torque-control response while limiting periodontal ligament stress. Mesh-refined finite-element analyses, objective-function robustness testing and Monte Carlo uncertainty propagation were performed. Three representative designs, reference, stress-constrained and objective-optimised, were fabricated and evaluated using an in vitro force/torque measurement setup.

RESULTS: Forty-two finite-element evaluations were used for sample-efficient design screening. Compared with the reference design, the stress-constrained and objective-optimised designs increased simulated torque response by 32% and 86%, respectively. Mesh refinement preserved the predicted torque-response ranking. Uncertainty propagation consistently favoured the objective-optimised design under both baseline and conservative assumptions. In vitro force/torque testing reproduced the predicted ranking across the three representative designs, supporting the model prediction that increased aligner engagement and pressure-ridge contribution can improve torque-control output.

CONCLUSION: This study presents a reproducible preclinical screening framework integrating clinic-derived design questions, Bayesian optimisation, finite-element simulation, uncertainty propagation and in vitro biomechanical validation to support more rational clear aligner design before clinical testing.

Tea Tree Oil as a Bio-Based Solvent for Bioceramic Endodontic Sealer Removal

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Abstract

Introduction:

Bioceramic sealers are widely used in endodontic treatment due to their favourable properties. However, their removal during retreatment remains challenging because of their resistance to conventional techniques. Tea tree oil (TTO) is a natural solvent that could be a potential alternative or addition to current products and protocols. Accordingly, this study evaluated the effectiveness of TTO as a bio-based adjunctive solvent for bioceramic sealer removal.

Methods:

Thirty-two teeth were endodontically treated and obturated using gutta percha and bioceramic sealer before being stored for two months in Hank's solution to mimic intra-oral conditions. They were then retreated using two methods: (1) Reciproc files (VDW GmbH – Munich, Germany) with conventional irrigation and (2) with an additional step of TTO irrigation. Retreated teeth were scanned using a micro-CT scanner (Skyscan 1172, Bruker) and reconstruction carried out (NRecon, version 1.7.4.6). Volumetric analysis was undertaken using Fiji (ImageJ). Total volume difference before and after retreatment was analysed as well as the same for coronal, middle and apical volumes of the root. Data was converted into percentages for comparability. Statistical analysis was undertaken using IBM SPSS Statistics (version 31, IBM Corp) including Shapiro-Wilk, one-way ANOVA and Kruskal-Wallis tests.

Results:

Regarding total volume change, there was a higher mean difference in the enhanced irrigation groups compared to the conventional groups at an average of 84.1% compared to 76.6% but this was found to be statistically insignificant. Similarly, there was no significant difference between different sections of the tooth, which indicates that the coronal portion of the root filling was as easy to remove as the apical portion.

Conclusion:

There was some indication that TTO may be more effective against bioceramic sealers. However, a TTO-based blend may be more potent. Further research is required to construct the composition of an effective blend and test in similar conditions.

Exploring the Biomechanical Impact of Bruxism During Deep Bite Correction: A proposal for a Finite Element Analysis study

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Abstract

Background: The impact of bruxism on orthodontic correction of deep bite and its potential contribution to post-treatment relapse is poorly understood.

Aim: To use computational modelling (finite element analysis) to explore the influence of bruxism on vertical force distribution during deep bite correction and its potential role in relapse.

Preparatory work (completed):

1. Training workflow:

- Image acquisition: A representative cone-beam computed tomography (CBCT) was obtained to test the feasibility of the proposed modelling processes.
- Image segmentation: CBCT data was segmented in 3D Slicer to create a 3D model with separate regions for the maxilla, mandible and individual teeth.
- Model refinement: The models were cleaned and smoothed in Meshmixer. The periodontal ligament (PDL) is not visible on CBCT, so a uniform 0.2-mm PDL layer was mathematically generated around each tooth to improve biomechanical realism while maintaining computational efficiency.

1. Ethical approval was granted on 16.4.26 (DREC reference: 3433). A suitable CBCT demonstrating a deep bite has been identified and consent obtained for its use in the research.

Proposed methods for future work:

3D models will be prepared from the CBCT using the method outlined above. The 3D models will be imported to Rhinoceros to be refined and volumetrically meshed. Finite element analysis simulations will be subsequently performed in ABAQUS, where the material properties, boundary conditions, and contact interactions will be defined, followed by the application of orthodontic forces under normal and simulated bruxism loading conditions. Resulting stress and displacement patterns will be analysed and compared with a planned *in vitro* validation.

Porphyromonas gingivalis Lipopolysaccharide-driven macrophage inflammation: homo-stimulation suppresses whereas polymicrobial hetero-stimulation by oral Streptococcus spp. augments TNF α .

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Abstract

Periodontal disease (PD) is associated with a polymicrobial environment where dysbiosis results in an inflammatory response predominantly driven by bacteria such as *Porphyromonas gingivalis* in the periodontal pocket. Repeated sequential exposure to lipopolysaccharide (LPS) has been shown to regulate inflammatory responses by endotoxin tolerization of macrophages, whereas responses to other oral bacterial stimuli have not been as well investigated in the context of periodontitis. As such, the aim of this study was to compare endotoxin-induced macrophage inflammatory responses upon PG-LPS homo-stimulation with hetero-stimulation in the presence of two oral bacteria: *Streptococcus sanguinis* (associated with healthy gingiva) and *Streptococcus mutans* (a prominent cariogenic pathogen). THP-1 pro-monocytes were differentiated to pro-inflammatory M1-like macrophages, for 72 hours, in the presence of Phorbol 12-myristate 13-acetate. Macrophages were either pre-stimulated with PG-LPS or heat inactivated *S. mutans* or *S. sanguinis* for 24 hours, after which were then stimulated with PG-LPS for a further 20 hours. Supernatants were then harvested and assayed for the pro-inflammatory cytokine, TNF α , by sandwich ELISA. Repeated homo-stimulation of macrophages by PG-LPS resulted in suppression of TNF α secretion by 80% of single-stimulus control. In the case of pre-stimulation with *S. mutans*, TNF α production was augmented by 64% over PG-LPS stimulation, whereas pre-stimulation with *S. sanguinis*, augmented PG-LPS-induced TNF α production by 46%. PG-LPS homo-stimulation potentially regulates inflammation by endotoxin tolerization whereas the augmented TNF α response induced by pre-treatment with *Streptococcus* spp, by a process representative of trained immunity, may contribute to the overall tissue-destructive inflammation characteristic of PD and indicate a synergistic relationship between *Streptococcus* spp and *P. gingivalis* during dysbiosis. The repeated stimulation of oral mucosal macrophages by PG-LPS alone or by multiple microbial stimuli, representative of polymicrobial infection, would appear to represent the molecular ON-OFF switch controlling or enhancing pathological inflammation.

Optimization of 3D printed P3HB/PCL scaffolds for guided bone regeneration: a two-stage design of experiments approach

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Abstract

Objective

Guided bone regeneration (GBR) is widely used to restore alveolar bone defects prior to implant placement. Current scaffold materials often exhibit poor mechanical performance and limited degradation control. This study aimed to develop a poly(3-hydroxybutyrate)/poly(ϵ -caprolactone) (P3HB/PCL) scaffold system via melt extrusion-based 3D printing, using a two-stage design of experiments (DoE) strategy to optimise seven key printing parameters and improve scaffold quality.

Methods

P3HB (Biomer®, ~550 kDa) and PCL (Sigma-Aldrich, ~80 kDa) were selected for complementary properties - stiffness and biocompatibility from P3HB, toughening from PCL. Scaffolds (16×16 mm, 0/90° lay-down, 1500 μ m fibre spacing, 0.4 mm nozzle) were designed in SolidWorks with custom G-code written in Sublime Text, with compositions ranging from 100% P3HB to P3HB/PCL blends. Scaffolds were fabricated on a Cellink Bio X6 pneumatic extrusion bioprinter in two stages: a seven-factor Definitive Screening Design (DSD) for Stage 1 (n=17), assessing printability, fibre diameter consistency, and warping as responses and a Box-Behnken Response Surface Methodology (RSM) for Stage 2 (n=15), optimising the most significant factors from Stage 1. Thermal characterisation by differential scanning calorimetry (DSC) and morphological analysis by scanning electron microscopy (SEM) were performed. Data were subjected to statistical analysis after normality tests.

Preliminary Results

Thermal analysis confirmed reproducible melting transitions for P3HB (~148°C) and PCL (~58.6°C), consistent with differing crystallinity and degradation behaviour, suitable for melt extrusion processing. SEM characterisation demonstrated well-defined pore architecture and satisfactory inter-layer bonding. Clear differences were observed between scaffolds across the seven input conditions. The two-stage DoE approach will further identify key parameters influencing scaffold quality, defined by consistent fibre morphology, minimal warping (<0.5 mm), and high printability.

Conclusion

This structured two-stage optimisation framework establishes a reproducible fabrication platform for P3HB/PCL composite scaffolds, addressing the lack of structured process optimisation in extrusion-based bone tissue engineering.

Development of immunocompetent organotypic models to investigate *Candida albicans*-host interactions and novel therapeutics.

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Abstract

Introduction

Candida albicans is an opportunistic pathogen and part of the oral microbiome. In health, it exists as a yeast, but environmental changes can trigger candidiasis through activation of virulence factors including filamentation (yeast-to-hyphae transition). Pilocarpine hydrochloride (PHCl), a non-specific muscarinic agonist, inhibits *C. albicans* filamentation *in vivo* and *in vitro*. Additionally, PHCl may prevent infection-induced tissue damage through modulation of host immune responses.

Aims

This project aims to develop an industry-accessible immunocompetent 3D organotypic oral mucosa model to dissect the *C. albicans* infection microenvironment and evaluate the effects of PHCl on pathogen virulence and host immune responses.

Methods

THP-1 and MUTZ-3 monocytic cell lines were differentiated into dendritic cells (DCs) and compared with primary CD14+ monocyte-derived cells using ELISA, flow cytometry, neurotransmitter gene expression panels, and functionality assays. TR146 buccal carcinoma cells were cultured to form a stratified epithelium at the air-liquid interface atop collagen-embedded primary oral fibroblasts. Differentiated DCs were co-cultured within the collagen matrix, and the model was apically infected with *C. albicans* ± PHCl. Tissue integrity was assessed using TEER, H&E staining, and immunostaining.

Results

A reproducible stratified 3D buccal epithelium model was established. MUTZ-3-derived DCs more closely resembled primary monocyte-derived DCs than THP-1-derived cells. Neurotransmitter profiling identified muscarinic receptor expression across all DC types. *C. albicans* infection induced filamentation, which PHCl inhibits. Fibroblast and immune cell incorporation into the model is ongoing, alongside investigations into the immunoregulatory capacity of PHCl.

Conclusions

There are no immunocompetent, physiologically relevant, industry-friendly oral mucosa models suitable for testing oral actives, drug delivery systems, nicotine patches, or oral mucosal infections. This human-relevant model bridges the gap between *in vitro* and *in vivo* studies without animal use, supporting the 3Rs principles. Furthermore, it enables investigation of *C. albicans*-host interactions and assessment of therapies, specifically PHCl, for mucosal candidiasis.

Establishing 3D Human Salivary Gland Spheroids to Model Radiation Damage

Nour zegalie

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Abstract

Radiotherapy is a life-saving treatment for head and neck cancers; however, irradiation of the salivary glands frequently results in xerostomia, significantly reducing patients' quality of life. Much of our current understanding of salivary gland biology and radiation response is derived from in vivo animal models, which, while informative, do not fully replicate the complexity and clinical relevance of human tissue. To address this limitation, we developed in vitro three-dimensional (3D) spheroid models of human parotid cells using AggreWell™ plates and evaluated their growth and differentiation under three distinct culture conditions: keratinocyte growth medium (KGM), enriched medium supplemented with R-Spondin1 and Wnt3a conditioned media, and enriched medium containing additional growth factors. Human parotid spheroids were successfully maintained for up to 14 days and exhibited compact, stable morphology across all culture conditions. Complementary studies in two-dimensional cultures demonstrated functional differentiation, with amylase expression confirmed by PCR and supported by analysis of culture media collected after 14 days. To model clinical radiotherapy, spheroids were exposed to fractionated irradiation at 2 Gy daily for five consecutive days, followed by assessment of metabolic viability, DNA damage, and gene expression by PCR. Collectively, this work demonstrates the feasibility of establishing human parotid spheroids as a translational model for studying radiation-induced salivary gland dysfunction and provides a platform for future investigations into radioprotective strategies for patients undergoing head and neck radiotherapy.

Isolation and characterisation of new strains of Actinobacteria and Saccharibacteria

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Abstract

Background:

The ultrasmall bacteria Saccharibacteria (formerly TM7) were initially detected in several environments such as the oral cavity but have now been co-cultured with their specific host bacteria that belong to the Actinobacteria family. Owing to their ultrasmall size and reduced genome, they likely rely on their host to survive and grow. In some situations, Saccharibacteria have been shown to kill their host bacteria and reduce inflammation associated with periodontitis. Due to limited cultivation of Saccharibacteria, little is known about why these bacteria are so host-specific.

Project aim:

The aim of this project is to isolate *Actinomyces* and/or *Schaalia* that act as potential host bacteria for Saccharibacteria, which will allow characterisation of the mode of interaction between these bacteria.

Methodology:

Actinobacteria were isolated using Mupirocin-Metronidazole blood agar (MMBA). Suspected Actinobacteria were identified by MALDI-TOF and whole-genome sequencing. The 'baiting method' was used with the new strains of Actinobacteria to enrich Saccharibacteria from healthy saliva. Saccharibacteria were confirmed and characterised using phase contrast microscopy, Field Emission Gun Scanning Electron Microscopy (FEG-SEM), and colony PCR.

Results:

Twelve Actinobacteria strains were isolated, including a novel strain *Actinomyces graevenitizii* which frequently co-isolates with Saccharibacteria but has remained uncharacterised. Against six distinct strains of Actinobacteria, eleven strains of Saccharibacteria were isolated and reached complete symbiosis by passage five. Saccharibacteria were often seen to cluster around host bacteria and be free-floating. Against *Actinomyces oris* (NU178) and *Actinomyces graevenitizii* (NU177) Saccharibacteria were in high abundance during passage three and led to lysis of their host bacteria.

Conclusions:

We have isolated several new strains of Actinobacteria and Saccharibacteria that can now be used to investigate interactions, for example in microfluidics biofilm models.

Supplementary methods in conjunction with rapid maxillary expansion of the midpalatal suture using animal models: A systematic review

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Abstract

Background: Rapid maxillary expansion is an established treatment for maxillary transverse deficiency, however, relapse remains a challenge. Numerous supplementary biological, pharmacological and physical interventions have been investigated in animal models with the aim of enhancing sutural bone formation during and following expansion. This review aimed to synthesise this evidence, particularly evaluating transverse skeletal effects and methodological quality.

Methods: A systematic review was conducted (PROSPERO Registration CRD420251267459). MEDLINE, Embase, Web of Science and Scopus were searched from January 1970 to December 2025, supplemented by grey literature and citation searching. Eligible studies included mammalian animal experiments evaluating rapid expansion of the midpalatal suture using a supplementary intervention. Study selection, data extraction and analysis were performed independently by two reviewers. Risk of bias was assessed using the SYRCLE tool, and certainty of the evidence was evaluated using the GRADE approach. Findings were examined across studies with consideration of the direction, consistency and strength of the reported effects.

Results: Forty studies met the inclusion criteria, involving 1456 animals. Rats predominated, with limited use of rabbits, mice and a single canine model. Supplementary interventions consistently modified biological parameters and bone microarchitecture. However, a significant increase in transverse skeletal separation beyond that achieved by mechanical expansion alone was uncommon. Only a small number of studies reported greater sutural or arch width attributable to the supplementary intervention, and these findings were not replicated across models. Risk of bias was unclear or high across most domains. The certainty of the evidence was very low.

Conclusions: In animal models, adjunctive interventions used alongside rapid maxillary expansion appear to influence sutural biology and remodelling rather than increase the magnitude of skeletal expansion. The evidence base is limited by substantial heterogeneity, lack of replication, and methodological shortcomings. Consequently, current evidence is insufficient to support translation of these interventions into clinical practice.

A Systematic Review of the Quality of Commercially Available Oral Health Promotion Mobile Applications

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Abstract

Background Oral diseases affect over 3.5 billion people globally, imposing substantial economic and quality-of-life burdens. Mobile health (mHealth) applications represent an emerging avenue for scalable oral health promotion, yet significant gaps remain between available products and what is needed to support evidence-based behaviour change.

Aim To systematically evaluate the quality of commercially available oral health promotion apps across three domains: evidence-based content, incorporation of behaviour change techniques (BCTs), and user engagement.

Methods A systematic review was conducted following JBI and PRISMA guidelines. Seven databases (MEDLINE, CINAHL, EMBASE, Global Health, Scopus, Web of Science, and Google Scholar) were searched from January 2000 to September 2024. Eligible studies were peer-reviewed empirical investigations evaluating apps using expert-reported outcome measures. Two reviewers performed screening and data extraction. Methodological quality was appraised using the JBI Critical Appraisal Tool for Analytical Cross-Sectional Studies. Heterogeneity in assessment tools precluded meta-analysis; findings were synthesised narratively.

Results Ten cross-sectional studies were included, evaluating 7 - 54 applications each. Most were conducted in high-income countries; two were rated low risk of bias. Evidence-based content was the most consistently underperforming domain; few apps cited clinical guidelines, and all five studies using the Mobile App Rating Scale (MARS) excluded its evidence-base item due to absent data. Basic BCTs including goal-setting, feedback, and information provision were common, whereas advanced strategies were largely absent. User engagement scores were variable, with gamification-oriented apps performing better.

Conclusion While technological advancements call for innovative public health solutions, oral health promotion remains rooted in conventional approaches. Commercially available apps show promise but demonstrate considerable variability in quality, with notable deficiencies in evidence-based content and BCT integration. Standardised evaluation frameworks and regulatory incentives for scientific validation are needed. Policymakers should consider funding clinically robust, publicly endorsed tools, particularly for underserved populations where mHealth holds the greatest potential to reduce inequalities.

