24th European Dental Materials Conference, London

Problems, Solutions and Innovations in Dental Materials

30.8. 2017 -1.9.2017

Barts and The London School of Medicine and Dentistry, Queen Mary University of London

Abstracts
&
Delegate Information Booklet

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Welcome

Dear Delegate

It is with great pleasure we welcome you to the 24th European Dental Materials Conference at Barts and the London, School of Dentistry, London, 30th August to 1st September 2017.

This conference is held every two years and has been hugely popular amongst academia and industry for many years, with internationally renowned speakers and up and coming scientists and clinicians. Our most recent successful meetings were in Cork (2005), Leeds (2007), Manchester (2009), Turku (2011), Birmingham (2013) and Nuremberg (2015).

The theme for this year is Problems, Solutions and Innovations in Dental Materials. Speakers will present research showing solutions and innovations in topics such as bioactive glasses, glass-ceramics, polymer/composites, and cutting-edge research techniques. This work will include real clinical outcomes in implantology, restorative and regenerative dentistry and use of new analytical techniques. For the first time we will be providing postgraduate student training in a workshop, “How to write a scientific paper for publication”. This will take place on the 30th August 2017 under the guidance of prestigious Journal Editors and will enhance personal development.

We wish you a most successful and enjoyable conference and thank you for attending.

Best Wishes,

Dr Mike Cattell - EDM Chair
Drs Mangala Patel, Sandra Parker, Maisoon Al-Jawad and Saroash Shahid - EDM organising committee

Table of Contents

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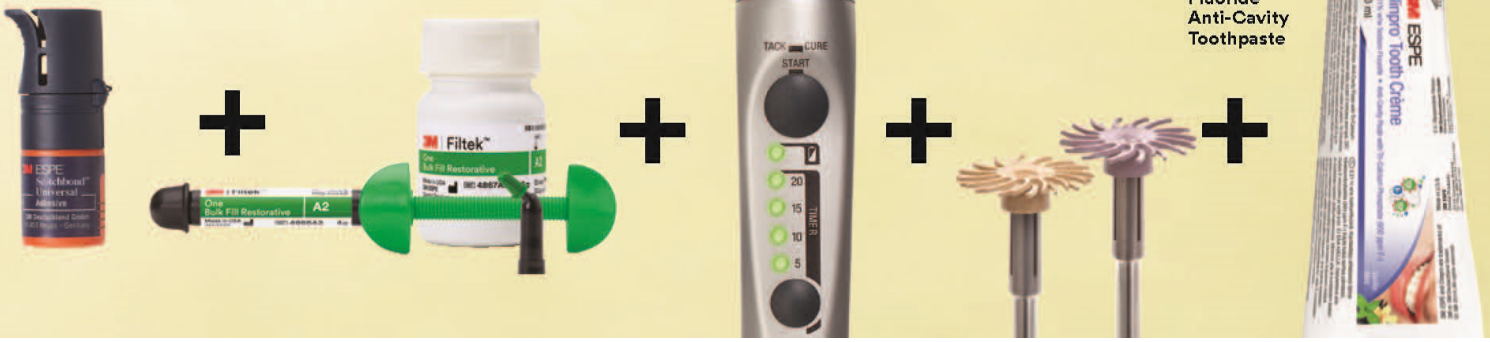


Conference Information

Dear Delegate,

Welcome to the 24th European Dental Materials Conference in London. Thank you very much for registering and attending. The following information should be helpful for your visit.

Accommodation

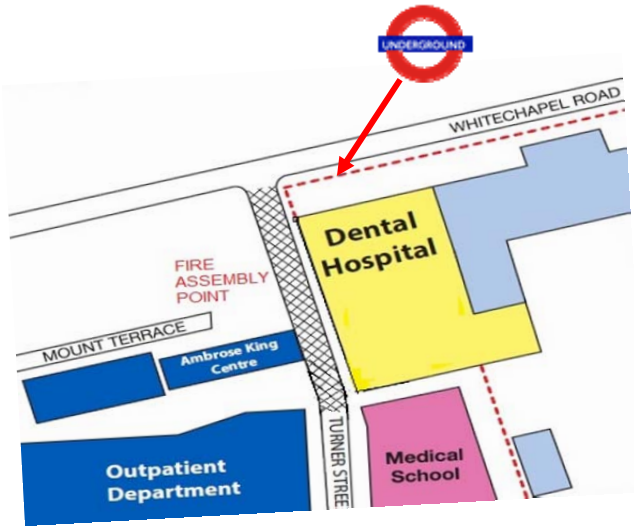
The accommodation is based at our Mile End campus and you should have been sent all the details when booking online. The nearest tube station is Mile End, which you exit left and walk straight (5-6 mins) until you hit the campus where you will need to pick up your keys for your accommodation.

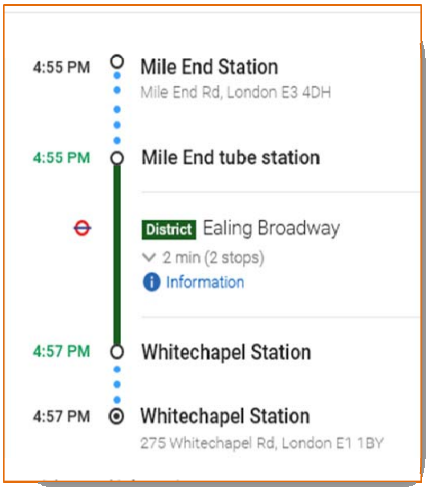
Maps and journey planning can be found at:
http://www.qmul.ac.uk/about/howtofindus/mileend/index.html

How to get to the Conference

By Tube

The closest tube station is Whitechapel which is on the Hammersmith and City line and the District line*. It is a 3 min walk from the station, see below.





*Please note you can travel by any District line trains (westbound).

Maps and journey planning can be found at:
http://www.qmul.ac.uk/about/howtofindus/whitechapel/index.html

By Train
Liverpool Street is the nearest National Rail station and it is a 15-20 minute walk.

By Car or Taxi
There is no public parking at the hospital itself so we encourage visitors not to travel by car whenever this is possible. If you do need to drive there is limited metered parking available on streets around the Hospital. Meters can be found on the following streets: Turner Street, Ashfield Street, Varden Street and Cavell Street.

Conference Venue

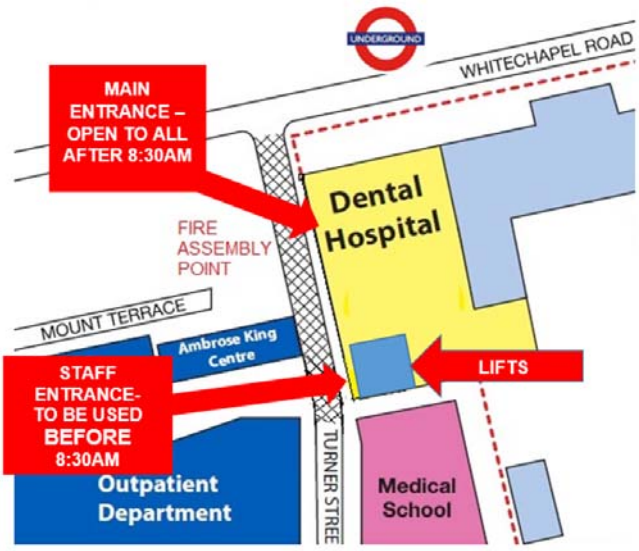
The Conference will be held in the Institute of Dentistry in the Bearstead Lecture Theatre which is located in the basement of the Dental School.

Address: Institute of Dentistry, Barts and the London School of Medicine and Dentistry, New Road, London, E1 2AD.

Arrival:

- Delegates can use the staff entrance from **08:00 am-08:30 am**. From **08:30** am the main doors open and signs will direct delegates towards the lifts.

- Delegates will be directed to the **Bearstead Lecture Theatre** in the basement to collect name badges and the conference will start at **9.00am** on 31st August.



The Schedule of the conference events/scientific programme and timings can be found at:

http://www.european-dental-materials.com/program/schedule-of-events.php

Health and Safety

Please be aware of the fire exits and assembly point (see map); a continuous alarm means evacuation.

Conference Reception

The EDM reception will be at the Charterhouse at Charterhouse Square, London, EC1M 6AN. It will be held in the great Chamber where Queen Elizabeth and King James I both held court (Conducted tours will be available).

The reception is on **30th August 2017** and will start from **6.30pm until 10.30pm.**

Maps and journey planning can be found at:

http://www.qmul.ac.uk/about/howtofindus/charterhouse/

This venue is off site and a short tube ride from the Mile End campus where your accommodation is booked. You should therefore allow 25-35 mins to reach the Charterhouse if travelling from Mile End tube station (this includes the short walk).

Members of staff will be provided to take you to the venue at the following location/ time:

Entrance (foyer) of the Main Queens building at the **Mile End Campus at 5.30pm.**

Conference Dinner

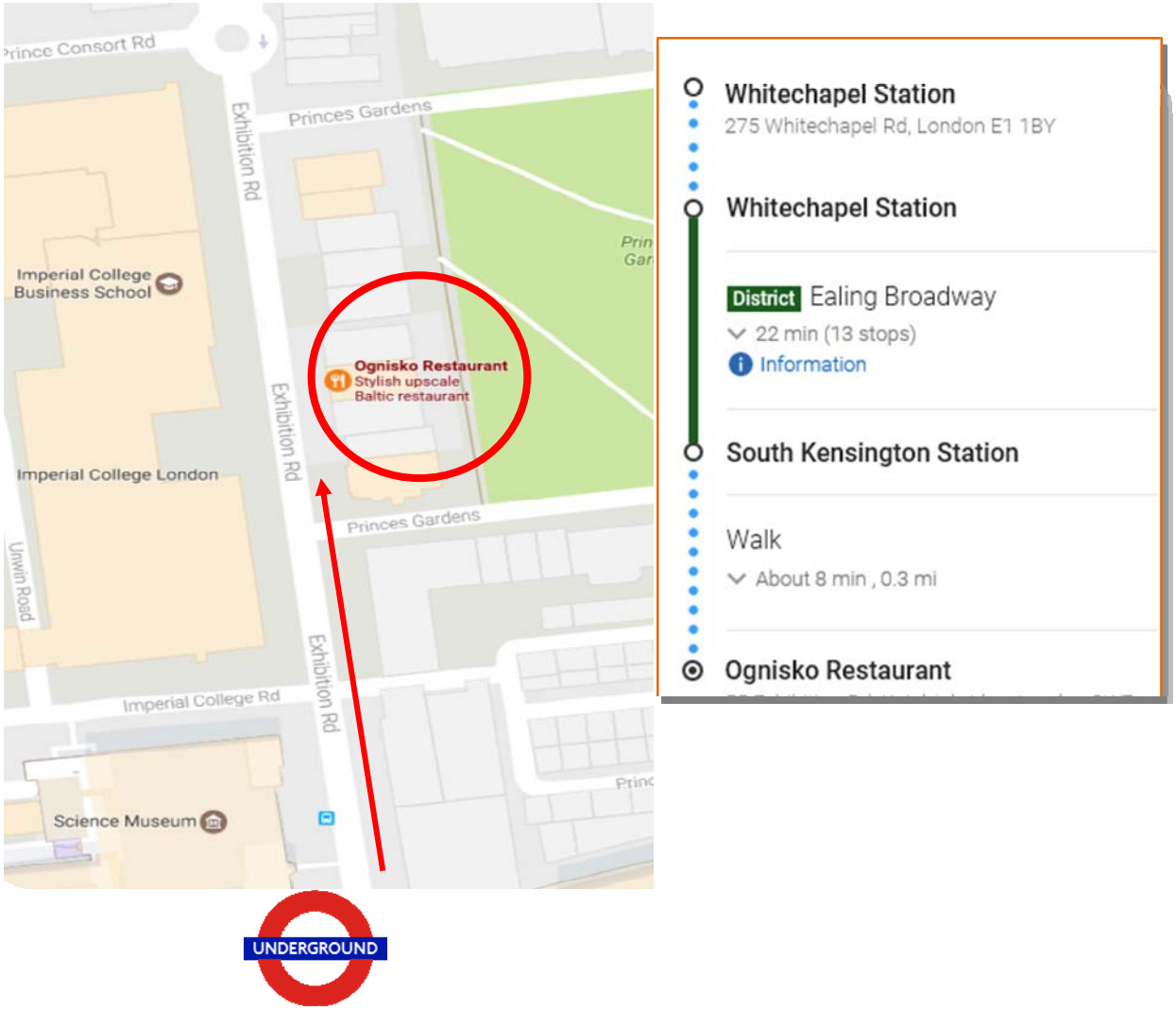
The EDM dinner will be at Ognisko Bar and restaurant at 55 Princes Gate, Exhibition Road, South Kensington, London, SW7 2PG.

The dinner is on **31st August 2017** and will start from **6.30-7pm until 12.0 pm**.

- The evening entertainment will be a prosecco reception, followed by dinner and a live band!

DIRECTIONS

From Whitechapel or Mile End tube station take any west bound district line train to South Kensington tube station. It is a 5-8 min walk from the station.



Useful Contacts

Sally McFadyen Mobile- 07960 947905 (Help with Posters).

Chad Cluff (ITC), Landline: 020 7882 6317 or Mobile: 07789 680410 (9am-5pm).

Porters – Security - 020 7882 2599.

Mike Cattell Mobile- 07833 697074 (Conference chair)

Mangala Patel 07931709166 (Conference organising Committee)

FIRST AID/ EMERGENCIES

The first aiders for the conference are as follows:

Mr Adel Houmani: Mobile- 07783 231633
Mr Chad Cluff: Mobile- 07789 680410
Mr Ron Thomas: Mobile- 07931 760308

There is an accident and emergency department located in the main hospital building opposite the tube station. In case of an emergency ring 999.

Scientific Program

DAY 1 – Postgraduate student workshop

Chair: Prof Farida Fortune

10-12am "**How to write a scientific paper for publication**". Dr Fleming, Prof. Palin, Dr Silikas and Prof. Ilie. Editors for: J. Dent, Dent Mater, Euro J. Pros Rest Dent.

1-3 pm: Introduction to Presentation/Voice Skills. Joseph Quinn (joseph@influencingnow.com).

DAY 2 Theme (AM): Bioactive Glass/Glass-Ceramics Problems, Solutions and Innovations

9.00: Welcome, Organisation: Chair/Dr Mike Cattell

9.30: Bioactive glasses past, present and future. Prof. Robert Hill (Barts and the London, School of Dentistry, London, GB).

10.00: Bioactive glass innovations for use in toothpastes. Prof. Delia Brauer (Otto-Schott-Institute, Friedrich-Schiller-Universität Jena, D).

10.30-11.00: Coffee Break

11.00: Use of bioactive materials to address Problems in Implantology. Dr Shakeel Shahdad (Consultant in Restorative Dentistry, Barts Health NHS Trust, GB)

11.30: Bioactive cements; solutions to a bone cement problem. Dr Natalia Karpukhina (Barts and the London, School of Dentistry, London, GB)

12.00: Apatite-wollstonite glass ceramics; effect of strontium substitution on the structure and on physical and biological properties. Prof. David Wood (School of Dentistry, University of Leeds, GB)

12.30-1.30 Lunch and Poster Display

DAY 2 Theme (PM): Bioactive Glass/Glass-Ceramics Problems, Solutions and Innovations

Chair: Dr Mike Cattell

1.30: **Is there an issue with YTZP Ceramics? A Conference Debate.** Dr Gary Fleming (School of Dental Sciences, Trinity College, Dublin, Eire). Prof. Martin Rosentritt (Department of Prosthodontics, University Hospital Regensburg, D).

2.15: **Design of leucite glass-ceramics using Appen factors**. Dr Xiaohui Chen (School of Dentistry, University of Manchester, GB).

2.45-3.15: **Coffee Break**

3.15: **Evaluating crystallisation mechanisms in novel glass-ceramics using TEM.** Dr Christian Patzig (Fraunhofer Institute for Mechanics of Materials IWM, D).

3.45: **Innovations in Glass-Ceramic Technology for Dental Materials.** Mr Marcel Schweiger (Director R&D Inorganic Chemistry, Ivoclar-Vivadent, Liechtenstein).

4.15: **Adhesive Cementation and the Strengthening Of All-Ceramic Dental Restorations**. Prof. Owen Addison (Consultant in Restorative Dentistry, School of Dentistry, University of Birmingham/ University of Alberta).

4.45: **Mike Cattell**: Closing remarks for Day 2.

6.30: **Conference Dinner:** Ognisko Bar and restaurant at 55 Princes Gate, Exhibition Road, South Kensington, London, SW7 2PG.

DAY 3 Theme (AM): Dental Composites/Polymers Problems, Solutions and Innovations

8.45: **Welcome, Organisation**: Dr Mike Cattell. **Chair**: Dr Sandra Parker

9.00: **Complex Number Aspects of Resin-Monomers and Composites**. Prof. David Watts (School of Dentistry, University of Manchester, GB).

9.30: **Biomimetic flake glass composites**. Dr. Saroash Shahid (Barts and the LondonSchool of Dentistry, London, GB).

10.00: **The next wave of bulk-fill resin composites: designing deep cure with reduced translucency**. Prof. Will Palin (School of Dentistry, University of Birmingham).

10.30-11.00: Coffee Break

11.00: **Characterisation of nano-mechanical properties of resin-composites**. Prof. Nicoleta Ilie (Dental School of the Ludwig-Maximilians-University, Munich, D).

11.30: **Behaviour of fast curing resin composites: getting the formulation just right**. Mr Luke Randolph (Institute of Condensed Matter and Nanosciences, Université catholique de Louvain, Belgium).

12.00: **Self-adhesive remineralising and antibacterial composites**. Prof. Anne Young (UCL Eastman Dental Institute, GB).

12.30: **Aspect of bonding: Controlling collagen degradation in hybridised dentin/resin interfaces**. Prof. Arzu Tezvergil-Mutluay (Institute of Dentistry, University of Turku, Finland).

1.0-2.15: **Lunch and Poster display**

DAY 3 Theme (PM): Materials Characterization Problems, Solutions and Innovations

Chair: Dr Graham Davis

2.15: NMR and structure property relations in biomaterials. Dr Robert Law (Imperial College, UK).

2.45: FIB-SEM 3D tomography of biomaterials. Dr Urszula Stachewicz (AGH University of Science and Technology, Poland).

3.15: Diffraction tomography as it relates to dental hard tissues. Dr Samera Siddiqui (Aarhus University, Denmark).

3.45: Aerospace materials. Dr David Tilbrook (Technical Fellow, R and D Leader, Aerospace Composites and Adhesives, Hexcel Composites Ltd).

4.15: Poster award - Dr Mike Cattell : Closing remarks/ look forward

4.30: Conference Closes

Poster Program

Poster Abstracts Page

Poster Abstracts

POSTER #1

Effect of Micro Retentive Groove for Bond Strength after Decontamination

Akikazu Shinya[1,2]*, Akinori Niitsuma[1], Sakura Shiratori[1], Soichi Kuroda[1], Harunori Gomi[1]
[1] The Nippon Dental Univ., Tokyo, Japan, [2] Turku Univ., Turku, Finland

Objectives: The factor of bond strength can divide into chemical adhesion and mechanical interlocking. We especially focused on the mechanical interlocking to improve the quality of adhesion to CAD/CAM fixed prosthetic. The novel processing of crown inner surface using CAD/CAM was projected to shape deliberate groove (Micro Retentive Groove: MRG). The purpose of this study was to investigate the effect of decontamination process by MRG shaping resin crown on the pull-out bond strength of a glass ionomer cement.
Methods: Master model was designed with a height of 3.5mm, diameter of 6mm, 1.0mm round marginal finish line 6° for each axial wall. Forty CAD/CAM crown were made of the prepared resin blocks (CERASMART: GC) by using GN-1000(GC), ten of those were without MRG, the others were MRG groups. Before bonding, without MRG specimens were divided to two groups (N: 5), i.e.) sandblasted (NOR) and contaminated by saliva (SAL). For the MRG groups were included five saliva contamination groups and no contamination group (CON). MRG groups with saliva contamination was classified into five groups, i.e.) air drying (DRY), rinsed with water spray (RIN), phosphoric acid etching (ETC), rinsed with 70% ethanol (ALC), sandblasting with 50µ alumina (ALU). For the all groups, the glass ionomer cement (Fuji I: GC) was used as a cement. After water storage at 37°C for 24h, the specimens were submitted to a pull-out bond strength test, and the data was analyzed with one-way ANOVA (a=.05)
Results: The highest pull-out bond strength in CON was showed 5.4±0.8 (MPa). The one-way ANOVA showed no significant differences between the MRG (CON, DRY, RIN, ETC, ALC, ALU) and NOR.
Conclusions: Within the limits of the study, it may be concluded that effect of MRG to CAD/CAM fixed prosthetic was indicative no significance bond strength, regardless of cleaning methods for saliva contamination.

POSTER #2

Effects of different drinks on stainability of dental ceramic materials

Gao Fei, Luo Xiao-ping* and Huan Lijuan
Department of Prosthodontics, Nanjing Stomatological Hospital, Nanjing University, Nanjing 210008，China

Objectives: To evaluate the stainability of IPS Empress CAD, IPS e.max Press, IPS e.max CAD and Vita Mark II) upon exposure to different staining agents.
Materials and methods: Forty flat specimens (1 mm in thickness, n=20; 0.5 mm in thickness, n=20) were fabricated for each of IPS Empress® CAD), IPS e.max® Press, IPS e.max® CAD and Vita Mark II ceramic materials, according to the manufacturer's instructions. All of the specimens were wet-ground and polished on a grinding machine. The ceramic material specimens were divided into 4 groups (n=5) and stored for 8 days at 37°C in four different types of solutions: coffee, red wine, green tea and black tea. Color of all specimens was measured before and after immersion with a colorimeter using CIE L*a*b* system, and color changes (ΔE) were calculated using the fomula $\Delta E=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$. The data were analyzed with a standard two-way analysis of variance (ANOVA), and mean values were compared by the Tukey HSD test ($\alpha=0.05$).
Results: For IPS Empress® CAD, the lowest ΔE values were observed in Group Coffee (0.12, 0.12) and Group Red Wine 0.13, 0.14). The highest color difference was observed in Group Green Tea (0.50, 1.08). For IPS e. max® Press, the lowest color difference was observed in Group Coffee (0.19, 0.22), while the highest color change was observed in Group Black Tea (1.07, 0.88). For IPS e.max® CAD, the lowest color difference was observed in Group Coffee (0.10, 0.12). Group Green Tea (0.50, 0.55) and Group Black Tea (0.53, 0.56) demonstrated the highest color changes among this material. For Vita Mark II, the lowest color difference was observed in Group Coffee (0.24, 0.27). The highest color change was observed in Group Green Tea (3.39, 4.15), which is the highest color change among all the groups in this study. The color difference in Group Black Tea (1.73, 2.03) was also higher than other materials tested.
Conclusions: The largest color difference was observed in the Vita Mark II and it was found less color stable than other glass ceramic. Green tea and black showed higher discoloring capability compared to coffee and red wine.

POSTER #3

Characterization of Magnetic Bioactive Glasses for Treatment in Bone Defects

Razieh Kohkan[1], Tabassom Hooshmand[1]*, Davod Mohebbi-Kalhori[2], Seyed Mehdi Hashemi[3]
[1] Department of Dental Biomaterials, School of Dentistry/Research Center for Science and Technology in Medicine, Tehran University of Medical Sciences, Tehran, Iran, [2] Chemical Engineering Department, Faculty of Engineering, University of Sistan and Baluchestan, Zahedan, Iran, [3] Ali-ebne Abitaleb Hospital, Zhedan University of Medical Sciences, Zahedan, Iran

Objectives: Hyperthermia treatment by magnetic mesoporous glasses has been applied as potential therapeutic approaches for bone defects due to malignant tumors. The aim of this study was to synthesize and characterize the structural and biological properties of magnetic Fe-BG bioglasses for producing multifunctional glasses. The effect of addition of copper to the bioglass composition was also evaluated.
Methods: The two magnetic bioglasses Fe-BG (68% Si, 23% Ca, 4% P, 5% Fe) and Fe-Cu-BG (68% Si, 18% Ca, 4%P, 5% Fe, 5% Cu) were synthesized by template sol-gel method and the P123 copolymer was used as co-templates. TG-DTA (Differential Thermal Analysis) was done for defining the calcination temperature and thermal behavior of prepared powders. They were then calcined at 650 °C for 2 h to obtain the final MMBG (magnetic mesoporous bioglass). The formation of glasses was analyzed by Fourier Transform Infrared spectroscopy (FTIR), and X-ray diffraction (XRD). The morphology, particle size, composition, surface area, mesoporous structure and paramagnetic property were characterized using scanning electron microscopy (FE-SEM), Transmission electron microscopy (TEM), energy-dispersive X-ray spectrometer (EDX), The Brunauer-Emmett-Teller (BET) and Barrett-Joyner-Halenda (BJH), and vibrating sample magnetometer (VSM), respectively. In addition, the biological behavior (bioactivity, biocompatibility and antibacterial) of the bioglasses was evaluated for their applicability in bio-medicine.
Results: The characterization results displayed that the synthesized powders formed mesoporous glasses with nanoparticle morphology, good surface area and magnetic properties. Both bioglasses demonstrated suitable biological behavior. The magnetic properties of bioactive glass were increased by the addition of copper oxide. However, the best biocompatibility and antibacterial behavior were found for the Fe-BG compared to the Fe-Cu-BG.
Conclusions: The two bioglasses might have the capability for bone reconstruction for injuries due to tumor ablation in tissue engineering.

POSTER #4

Effect of Bioactive Glass Addition on the Characteristics of Glass Ionomer Cements

Saja Mannaa*, Natalia Karpukhina, Saroash Shahid
Dental Physical Science Unit, Institute of Dentistry, Barts and The London School of Medicine and Dentistry, Queen Mary University of London

Objectives: Glass Ionomer Cements are one of the widely used dental restorative materials. They have chemical adhesion to tooth structure, and anti-cariogenic properties due to fluoride release. Our aim is to develop GIC compositions containing bioactive glasses (BAG) and to evaluate the effect of varying BAG concentrations in the cement on the mechanical properties, and setting characteristics.
Methods: Alkali free fluoride containing BAGs were produced via melt quench route based on the composition 35.9SiO2-5.9P2O5-52.2CaO-6.0CaF2. Two fluoride containing calcium and strontium alumino-silicate glasses (ASG) were produced commercially at CDL, UK using a cold top furnace. Glass transition temperatures (T_g) were determined using Differential Scanning Calorimetry (DSC). Homogeneity of the glasses was evaluated using X-Ray Diffraction (XRD).
ASG powder was blended with 80KDa poly(acrylic acid)2.5:1 ratio. This was then mixed with 15% Tartaric acid solution at 3.5:1 powder: liquid ratio. The mixture was packed into Teflon mould (4mmx6mm), clamped and stored for 1hr at 37℃. Thereafter, the cylinders were removed and stored in deionised water for 24h at 37℃. BAG containing cements were produced using the same method except the ASG powder was pre-blended with 10%BAG. Samples (n=8 for each cement) were tested for compressive strength using Instron.
Oscillating rheometer was used to characterise the cements. Cements powder and liquid components were mixed for 20sec. Changes in oscillation were recorded as a measure of working-time (W_t) and setting-time (S_t).
Results: XRD patterns show that BAG and ionomer glasses were amorphous. T_g of ionomer glasses were lower than BAG. Compressive strength values are 90 ±14 SD(MPa) with 10%BAG, and 124±28 SD(MPa) for GIC with no BAG. W_t values are 0.84±0.05 SD(min) and 0.85±0.02 SD(min), S_t values are 1.48±0.1SD(min) and 1.49±0.1SD(min) for cements containing no,and 10%BAG respectively.
Conclusion: Addition of BAG has no significant effect on W_t and S_t. The compressive strength values are reduced with increasing BAG. This needs to be further investigated.

POSTER #5

Characterization of ion-leachable glass powders and light transmission of some ILG composite formulations.

Ahmed Almokhatieb*, Xiaohui Chen, David C Watts.
School of Medical Sciences, The University of Manchester, UK

Objective: To characterize ion leachable glass powders and measure light transmission of resin-composites formulated with these filler powders.
Materials and Methods: Scanning electron microscopy (SEM) and X-ray diffraction (XRD) were used to characterize 3 unsilanated ion leachable glasses (ILG), namely: bioactive glass (45S5), Fuji IX and Fuji IX extra powders. Seven resin-composite groups were formulated with 50:50 w/w BisGMA:TEGDMA, and a photo-initiator system of 0.5 wt% camphorquinone (CQ) with dimethyl-amino-ethyl-methacrylate (DMAEM). The composites had a constant filler fraction of 72 wt%. The filler phase comprised silanated barium borosilicate (BBS) powder with progressive substitutions of 10 or 15 wt% of the fillers by each of the ILG glasses. Un-cured disc specimens (4 x 2 mm, n=3) were prepared for each group. The specimens were each irradiated with a 1200 mW/cm^2 blue LED unit. Light transmittance, through each 2 mm thickness, was measured using a UV-visible spectrophotometer (MARC^{TM}-RC).
Results: The ion leachable glasses had a similar size distribution (0.02 to 2000 μm) with an average size ≈10 μm. SEM images showed irregular morphology of the particles with scratches on the surface due to the milling processes. The maximum transmitted irradiance obtained through the ILG composites was 680 mW/cm^2. But the BBS control group had a transmitted irradiance of 716 mW/cm^2. However, there were no statistically significant differences between the groups ($p > 0.05$).
Conclusions: The experimental ILG resin-composites demonstrated adequate light transmission through a 2 mm thickness, when the ILG substitutions were limited to 10-15 wt%.

POSTER #6

Biofilm Formation on Dental CAD-CAM Composite Block Materials.

Andrei C. Ionescu*, Gloria Cazzaniga, Marco Ottobelli, Mario Cerati, Eugenio Brambilla.
Department of Biomedical, Surgical and Dental Sciences, IRCCS Galeazzi Orthopedic Institute, Oral Microbiology Laboratory, University of Milan, Milan, Italy

Objectives Modern Dentistry is increasingly focusing on digital procedures, including CAD-CAM technologies. Secondary caries, however, is still the main reason for failure of dental resin-based composite (RBC) restorations. Few data are currently available on the mutual interactions between indirect composite surfaces and oral biofilms. The aim of the current study was to test the microbiological behavior of different CAD-CAM resin composite materials.
Methods Fifteen disks (diam=6.0 mm, thickness=2.0 mm) from each group **(Table)** were obtained by means of a diamond-coated trephine bur under water cooling. Specimens were polished, cleaned, stored in artificial saliva for one week, then sterilized for 24 h under UV. After 24 h pre-incubation with sterile human saliva, monospecific *Streptococcus mutans* biofilm was obtained for 24 h on the surfaces of the specimens, and the viable biomass adhering to the specimens' surfaces was measured using a tetrazolium dye-based test (MTT+PMS). Statistical analysis included verification of normality of distribution and homoscedasticity, then One way ANOVA and Tukey's HSD post-hoc test ($p<.05$).
Results Enamel yielded significantly highest biofilm formation; the direct RBC promoted significantly lower biofilm formation. No significant differences were highlighted between the three resin block materials **(Table).**
Conclusions The microbiological test was run under static conditions in a closed environment, therefore active principles or bacterial catabolites could not be dispersed. Therefore, fluoride release from the direct RBC caused a reduction in biofilm formation, while buffering of the culture broth by enamel demineralization prevented pH drop to low values hampering further bacterial development.

Table. Tested materials and biofilm formation displayed as means (±1SD).

Name, manufacturer	Type	24h biofilm formation (optical density units)
Katana Avencia, Kuraray Corp.	RBC, polymer-infiltrated-filler	1.022(0.096)b
Lava Ultimate, 3M ESPE	RBC	0.998(0.058)b,c
Enamic, Vita Zahnfabrik	Hybrid material, polymer-infiltrated-feldspatic ceramic-network	0.994(0.045)b,c
Grandio, VOCO GmbH	RBC for direct restorations	0.916(0.082)c
Human enamel	Reference	1.147(0.130)a

POSTER #7

Immobilization and Adherence of Chitosan on PMMA (Pilot study)

Katarzyna Walczak*[1], Klaus Boening[1], Heike Meissner[1], Mieszko Wieckiewicz[2]
[1]Department of Prosthetic Dentistry, Carl Gustav Carus Faculty of Medicine, Technische Universität Dresden, Dresden, Germany
[2]Department of Prosthetic Dentistry, Wroclaw Medical University, Wroclaw, Poland

Objectives: Previous studies showed that 2% chitosan acetate solution (CSA) bond to flat PMMA specimens. This pilot study investigated the possibilities of immobilizing the CSA for coating of curved denture bases.
Methods: Flat PMMA specimens (diameter 12.75 mm; height 6 mm) were manufactured, divided in five groups (n=4 each) and treated as follows:

Group 1: Sandblasting with Rocatec, CSA application, spraying with 0.1 mol NaOH. Turning the CSA covered surface 90° (perpendicular) to check stability of the CSA. If stable drying at 45°C for 120 min.
Group 2: as above but immersion in NaOH for 2 min instead of spraying.
Group 3: as above but immersion in NaOH for 5 min.
Group 4: as above but application of second CSA layer on dried first layer before immersion in NaOH (5 min).
Group 5: as group 4 but immersion of first dried (60°C) CSA layer in NaOH (10 min) before application of second CSA layer and repeated immersion in NaOH (5min).

Adherence of CSA was checked manually with a scalpel (subjective judgement: no adherence, fair adherence (to scraped off with some effort), good adherence (hardly to be scraped off)).
Results: Only immersion for 5 min in NaOH immobilized the CSA. After drying the CSA in group 3 showed no adherence, in group 4 fair adherence and in group 5 good adherence in all specimens.
Conclusions: 5 min immersion in NaOH immobilized the CSA effectively. However, immobilization with NaOH prior to drying process obviously inhibited the bond of CSA to the PMMA surface. Adequate CSA adherence to PMMA could be achieved using a thin first layer of CSA, which was first dried and neutralized with NaOH, serving as a bonder. The second CSA layer then can be applied as described in group 5 and adheres to the first layer.
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POSTER #8

Time-dependent Hardness Development of Self-adhesive Resin Cements

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Objectives: This study was conducted by observing hardness gradient and time-dependent hardness development of self-adhesive resin cements in simulated canals under dual- and self-curing modes.
Methods: Slots in light-proof silicon cylinders with one open end were filled with the following eight materials: a traditional resin cement {Duolink (DLK)}, a core build-up resin material {MultiCore Flow (MCF)} and six self-adhesive resin cements {RelyX Unicem 2 (RU), G-Cem (GC), Maxcem (MC), Biscem (BC), Multilink Speed (MS), PermaCem 2.0 (PC)}. The specimens were subjected to LED light intensity of 800 $mWcm^{-2}$ through their open ends for 20 seconds. The Knoop hardness (KHN) gradients of each polymerized material was measured after 1 hour and 120 hours. Surface readings were obtained in 1-mm intervals at 1 mm to 10 mm away from the open ends. The collected data were analyzed by 2-way ANOVA and the Student–Newman–Keuls (SNK) test (α= .05).
Results: All the resin materials had stable KHN at a certain depth at which their KHN by self-curing mode did not change any more (P>.05). The region before this certain depth was regarded as dual-curing mode and the KHN decreased gradually with depth at dual-curing mode (P<.05). Between 1 hour and 120 hours post-exposure, the ratios of the Knoop hardness numbers at 5-mm depth (chemical-cured) to those at 1-mm depth (dual-cured) were increased from 70.94% to 81.64% in DLK, and from 70.66% to 86.27% in MCF. However, the ratios of six adhesive resin cements changed differently: from 75.21% to 85.01% in RU, from 87.38% to 90.05% in GC, from 98.05% to 97.24% in MC, from 49.09% to 47.99% in BC, from 76.13% to 62.37% in MS, from 80.43% to 73.63% in PC.
Conclusions: Self-adhesive resin cements have lower chemical capability, which should take advantage of light irradiation whenever possible.

POSTER #9

Bioactive Orthodontic Adhesive for Prevention of White Spot Lesion

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Objectives: To characterise a novel orthodontic adhesive for bioactivity and the potential to prevent demineralisation around orthodontic brackets.
Materials and Methods: A light cured adhesive made from a novel, fluoride containing, bioactive glass (BAG) and a resin (BisEMA and TEGDMA) was characterised for its ions release following immersion in demineralising artificial saliva pH=4 (AS4) and remineralising artificial saliva pH=7 (AS7). Cured adhesive disks (n=30) of 10mm diameter and 1mm thickness were immersed in 10ml of the solution for 10 time points (6 hours -6 months). The resulting solution was investigated using pH meter, ion selective electrode (ISE) for F^- detection and inductively coupled plasma optical emission spectroscopy (ICP-OES) for Ca^{2+} and PO_4^{3-} detection. Orthodontic brackets were bonded on bovine teeth using either the BAG adhesive or Transbond™ XT (3M Unitek) as a control. The teeth with the brackets were immersed individually in AS4 for 24hours. The teeth with the brackets were scanned using the MuCAT2 X-ray microtomography (XMT) machine before and after acid treatment and the resulted scans were reconstructed and subtracted images were obtained.
Results: The cumulative fluoride release in AS4 is higher than in AS7 and the release continued along the immersion period. There was a release of 150-450ppm and 130-160ppm Ca^{2+} in AS4 and AS7 respectively and 1-10ppm PO_4^{3-} in both solutions. The pH of the AS4 solution rose to 6.8 at the final time point. The XMT images reveal that the BAG composite used in this study resulted in a significantly lower demineralisation of the enamel around the brackets compared to the control Transbond™ XT which demonstrated a remarkable radiolucency on the enamel surfaces surrounding the bracket with a significant difference in the values of the linear attenuation coefficient (LAC).
Conclusion: This novel bioactive glass composite is potentially a smart adhesive for bonding orthodontic brackets to prevent demineralisation.

POSTER #10

Influence of Thermal Stress on Simulated-wear of Nanofilled Resin Composites

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Objectives: This study investigated the influence of thermal stress on the simulated localized and generalized wear of nanofilled resin composites.
Methods: Six nanofilled resin composites were evaluated and then subjected to a wear challenge of 400,000 cycles in a Leinfelder-Suzuki (Alabama) wear simulation device after 24 hours of water storage (24-hour group) and 24 hours of water storage and 10,000 thermal cycles (TC group). Simulated localized wear was generated using a stainless-steel ball bearing, and simulated generalized wear was generated using a flat-ended stainless- steel cylinder. Wear testing was accomplished in a water slurry of polymethyl methacrylate beads. Simulated localized and generalized wear was determined using a noncontact profilometer (Proscan 2100) in conjunction with Proscan and AnSur 3D software.
Results: Wear was significantly different ($p<0.05$) among the resin composites for both simulated localized and generalized wear of either the 24-hour group or the TC group. The simulated localized wear of the TC group was significantly greater than that of the 24-hour group; however, the simulated generalized wear of most of the resin composites of the TC group was not significantly different from that of the 24-hour group.
Conclusions: The simulated localized and generalized wear of nanofilled resin composites is material dependent. The simulated localized wear of nanofilled resin composites appears to be influenced by thermal stress, whereas this effect is not as apparent in simulated generalized wear testing.

POSTER #11

Microleakage and bonding efficiency of cervical restorations after thermo-mechanical cycling

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Objectives: This study evaluated the extent of microleakage and bonding strength of three resin composites [bulk-fil flowable (BF), conventional flowable (CF), and conventional restorative (CR)] for the restoration of non-carious cervical lesions after thermo-mechanical load cycling.
Methods: Sixty extracted human premolars with buccal cervical cavities (3 x 2 x 2 mm) were prepared and allocated into three groups (n = 20): BF (Filtek Bulk Fill Flowable, 3M ESPE), CF (Filtek Z350 XT Flowable, 3M ESPE), and CR (Filtek Z250, 3M ESPE). Each cavity was etched with phosphoric acid and restored with Adper SingleBond 2 adhesive (3M ESPE) and a resin composite. The teeth were subjected to thermocycling and cyclic loading using a chewing simulator (CS-4.8 Kausimulator, SD Mechatronik). Microtensile and shear bond strengths were measured at the enamel-composite interface. Microleakage was evaluated at a cross-sectioned bonded interface after dye penetration of 0.5% methylene blue. Data were analyzed with Kruskal-Wallis and Mann-Whitney U tests for the microleakage assessment and one-way analysis of variance for the bond strength test (α=0.05).
Results: The BF group had a higher microtensile strength than that of the CF and CR groups ($p<0.05$). There was no significant difference in the shear bond strength among the groups. For microleakage at the dentinal interface, the CF group showed deeper dye penetration than that of the other groups ($p<0.05$).
Conclusions: Based on the assessment of the bond strength and marginal sealing in non-carious cervical restorations after chewing simulation, the bulk-fil flowable composite resin exhibited a favorable performance compared with the conventional restorative and flowable resin composites.

POSTER #12

Autonomic Self-healing Microcapsules in Dental Resin Composites: A Systematic Review

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Objective: To review the current literature on the new technology of self-healing microcapsules with dental resin composite material, and to evaluate the biocompatibility of self-healing microcapsules and the efficiency of repairing cracks within composite resin matrix.
Method: An electronic search was carried out using the following databases; PubMed; Ovid and Google Scholar with the keywords "Self-healing OR Self-sealing AND Dental resin composite", "Microcapsules AND Dental resin composite", "Self-healing OR Self-sealing AND Resin composite", "Microcapsules AND Resin composite".
Result: The search yielded a total of 7 studies involving self-healing approach with dental resin composites. After removing duplicates and non-English literature, one paper was excluded. Manual search of the references from the included article was carried out to identify missing literature and yielded 2 extra papers. The sum of 8 papers were discussed in this review, other literature including autonomic self-healing in polymeric matrix were briefly discussed. Dental resin composites commonly fail due to secondary caries and restoration fracture, micro-leakage of the restoration would allow secondary bacterial attack together with accumulation of micro-cracks will results in fracture propagation and restoration failure eventually. According to the current literature, when a stimulus of crack or damage occurs microcapsules ruptured and healing liquid released to repair and heal the crack with self-healing efficiency of up to 70%-90% recovery of the virgin fracture toughness within resin matrix, thus to reduce and prevent catastrophic failure of dental resin composite.
Conclusion: Self-healing strategies applied in resin composite materials to-date have essentially been bioinspired. The way forward is the detailed study of natural bleeding to permit true biomimetic self-healing approach in resin composite materials. Self-healing (DCPD), (TEGDMA-DHEPT) or (silica) microcapsules within dental resin composite have been shown promising results for self-repairing and crack inhibition indicating a prolong life time of dental composite restorations. More investigations and mechanical evaluations should be focused on self-healing technologies in dental resin composite.

POSTER #13

Micro – CT Evaluation of Microleakage of Class II Composite Restorations: an In-vitro Study.

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Objectives: To evaluate the microleakage patterns in II deep class using a 3 step etch and rinse bonding system and three different resin based materials. The null hypothesis of this in vitro study was that no difference of microleakage could be seen within the tested materials.
Methods: Mesio-Occlusal-Distal cavities were prepared in 30 freshly molars with the proximal mesial and distal margins located respectively 1,5 mm apically and 1,5mm coronally to the CEJ. Restorations were completed using a 3 step "Etch and Rinse" adhesive, margins were relocated using a microhybrid, preheated or flowable composite and restorations were than completed using a conventional composite. The specimens were isolated with nail varnish except for a 1-mm wide area around the margin and apex was sealed using epoxide cement and then thermocycled (1,000 thermal cycles, 5°C/55°C; 30-second dwell time). A 50% ammoniac AgNO3 solution was used as tracer according to Tay's protocol. Microleakage analysis was conducted using a microtomomography system Sky-scan 1072 (SKYSCAN, Kartuizersweg 3B 2550, Konitch, Belgium).
Results: Statistical analysis was conducted using Two-tailed t-test and ANOVA. The mean microleakage of all the tested materials showed greater leakage in the cementum margins; flowable composite exhibit greater leakage among the groups. Significant differences (P value < 5%) within groups in both enamel and dentin margins were present.
Conclusions: None of the tested materials eliminated marginal microleakage. Pre-heated composite showed significantly lesser microleakage than the others tested materials. Within the limitations of this in-vitro study can be concluded that a flowable composite should be avoided at the dentin/cementum margin.

POSTER #14

Light transmission of Novel Resin Composites containing Nano-Hydroxyapatite and Glass Flakes

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Objective: To evaluate light transmission of model resin composites containing nano-hydroxyapatite (nHAP) and glass flakes (GF).
Materials and methods: Premixed monomer of Bisphenol A glycidyl methacrylate (BisGMA): Triethylenglycol dimethacrylate (TEGDMA) 50:50 wt% was mixed with 0.5 wt% of Camphorquinone (CQ) and 0.5 wt% of 2-(Dimethylamino)ethyl methacrylate (DMAEMA). The photo-curable monomer was then mixed with 100:0, 75:25, 50:50, 25:75 and 0:100 of nHAP:GF at different overall filler fractions (30 to 60 wt%) in 5 wt% increments. Twenty-nine resin composite formulas were prepared. Specimens (n = 3) with 2 mm thickness and 4 mm diameter were cured for 20 s using a light cure unit (LCU; S10 Elipar 3M ESPE, USA) with a MARC^{TM} resin calibrator (BlueLight Analytics Inc., Canada) to evaluate the irradiance transmitted *through* the specimens. This transmitted irradiance was used to measure the effect of adding nHAP and/or GF. Statistical analysis was by one-way ANOVA ($p < 0.05$) followed by Tukey's Post-Hoc test.
Results: 11 groups were chosen where the composite specimens were adequately cured. The maximum transmitted irradiance [310 (4.13) mW/cm^2] was observed through the specimen containing 45 wt% nHAP. The lowest transmitted irradiance [166 (14.34)] was for resin composite containing 60 wt% of 50:50 nHAP:GF. Increasing amounts of filler reduced the irradiance. There was a statistical significant different between the transmitted irradiance of groups containing nHAP and 50:50 nHAP:GF at the same filler load.
Conclusion: Additions of nHAP to the resin composites gave greater light transmission compared to equivalent additions of glass flakes. Increasing filler loading reduced the light transmission.

POSTER #15

Surface Hydrophobicity of Universal Adhesives assessed by X-Ray Photoelectron Spectroscopy

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Aim: This study analyzed the chemical composition of the first 20nm of the external layer of five universal dentin bonding agents using X-ray Photoelectron Spectroscopy (XPS). The surface hydrophobicity and hydrophilicity was assessed by the deconvolution of the C1s peak. The atomic percentages of hydrophilic groups were contrasted with the hydrophobic backbone.
Methods: Prime & Bond Elect (Dentsply Caulk, Milford, DE, USA), iBond Universal (Heraeus Kulzer, Hanau, Germany), Scotchbond Universal (3M ESPE, St Paul, MN, USA), All-Bond Universal Adhesive (BISCO Inc, Schaumburg, IL, USA) and Clearfil Universal Bond (Kuraray Noritake Dental Inc. Sakazu, Japan) samples were prepared and polymerized according to the manufacturer's instructions with a Light-Emitting Diode unit (Ultradent- 750 mW). The samples (n=5) were analyzed by XPS (Kratos Axis, vacuum of 2x10-9 torr, an x-ray gun emission set to 15 mA, and an x-ray gun anode HT set to 15 kV, which equates a power setting of 225 W). XPS surveys and high-resolution scans were taken from the external layer (depth = 0nm, (D0)) and a sub-surface layer (depth = 20nm, (D20)) after removing the external surface with argon etching. C1s (at 285 eV) and O1s peaks were used to compare the deconvolution of the peaks. Results were analyzed using 2-way ANOVA (□=0.05).
Results: The table below displays the percentage of hydrophobic components of the tested universal adhesives. Statistically significant differences ($p<0.05$) of C1s peak components were found between D0 and D20 for all adhesives.
Conclusion: All adhesives in this study showed to have more than fifty percent of the surface content composed by hydrophobic chemical groups.

Adhesive:	D0	D20
P&B Elect	50.8 % (± 0.12)	60.2 % (± 0.54)
iBond Universal	52.2 % (± 0.43)	55.1 % (± 0.49)
Scotchbond Universal	65.3 % (± 0.18)	56.4 % (± 0.78)
All-bond Universal	64.8 % (± 0.73)	63.1 % (± 0.59)
Clearfil Universal	58.5 % (± 0.51)	57.3 % (± 0.38)

POSTER #16

Investigating the Validity of ISO 6872:20 'Dental Ceramics – Chemical Solubility

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Introduction: The present ISO 6872:2008-2015 'dental ceramics' advocates a standard methodology for measuring the chemical solubility of dental ceramics. This standard replaced the older method (1995) by replacing a refluxing method with a static solution method. Whilst the standard specifies the total surface area of the samples, it does not specify the individual sample geometry. Unfortunately, few published studies of chemical solubility have adhered to the ISO test.
Aim: The aim of this study was to investigate the validity of the chemical solubility method of the ISO 6872:2015 by altering the geometry of test specimens.
Methods: Zirconia was selected as the test material. The chemical solubility analysis was performed in accordance with ISO 6872:2015. Two different morphologies (cubes and spheres) were investigated, with six different size specimens investigated for each morphology whilst keeping the total surface area above the minimum indicated in the standard (>30cm^2). Each test was repeated three times to confirm the reliability. The surface microstructure of the specimens was analysed by scanning electron microscope before and after the chemical solubility test.
Results: It was found that the chemical solubility increases as the individual surface area of the cube specimens decreases. For spherical samples a similar, but less pronounced trend is seen. ANOVA indicated a significant difference between most of the cubic groups, and among some of the spherical groups. SEM images showed more dissolution in areas with small radius of curvature, such as edges and corners.
Conclusion: The current results indicate that the chemical solubility can be manipulated by altering the geometry of individual test specimens whilst still complying with the ISO 6872:2015 standard. The chemical solubility decreases with increasing individual sample sizes and is more pronounced in cubic samples, indicating that areas with small radius of curvature dissolve more readily as shown by SEM micrographs.

POSTER #17

Advanced Antimicrobial Thin Coatings for Dental Implants Functionalization

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Objectives: Ayurvedic medicine is one of the world's oldest medical systems. It is an example of a coherent traditional system which have a time tested and precise algorithm for medicinal plant selection, based on several ethno-pharmacophore descriptors whose knowledge endows the user to adequately choose the optimal medicinal plant for the treatment of certain pathology.
This work tries to link traditional knowledge with biomedical science by using traditional ayurvedic plants with antimicrobial effect in manufacture of thin films for implant protection.
Methods: We report on the transfer of novel polymer- ayurvedic extract-bioactive glass composites by matrix assisted pulsed laser evaporation to uniform thin layers onto dental implant. The targets were prepared by freezing in liquid nitrogen of mixtures containing polymer and ayurvedic extract, reinforced with bioglass powders and then were submitted to multipulse ablation with an UV KrF* (λ=248 nm, τ ~ 25 ns) excimer laser source. The behaviour of polymer- ayurvedic extract -glass/implant structure in condition which simulates the physiological environment was evaluated in vitro by complementary techniques.
Results: When in contact with body fluids, the coatings demonstrate the ability to stimulate the growth of biological hydroxyapatite on their surface, which validates the film bioactivity. Bioglass dissolution in human body fluids is accompanied by a prolonged release of antibiotic active molecules, an ideal circumstance for prevention of local infections.
Both polymer and apatite layer that grows on the implant surface four weeks after samples introduction into simulated body fluid, ensure a good protection against degradation and release of harmful metallic ions into the body.
The printed structures are highly biocompatible and resistant to microbial colonization and induce a significant delay in the microbial biofilm initiation and their further development.
Conclusions: The results emphasize the multiple advantages of these coatings which would allow to halt any leakage of metal and metal oxides to the biological fluids and eventually to inner organs (by polymer use), to speed up the osseointegration (due to the bioactive glass use) and to exert antimicrobial effects (by ayurvedic plants extracts use).
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POSTER #18

Imaging of Enamel Treated by 2.94 µm Er: YAG Laser Using X-ray Nanotomography

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Objectives: Destructive analysis of tooth structure might produce some artefacts leading to wrong conclusion or inaccurate assessment of the impact of laser radiation on the dental hard tissues. This paper demonstrates the use of a non-invasive, three-dimensional, high-focused X-ray nanotomographic technique for analysis of the impact of Er: YAG laser radiation on enamel tissue.
Methods: Enamel samples were taken from sound permanent premolar teeth. Two sections of enamel tissue were shaped to be wedge-like samples with about 50 µm thicknesses. The samples were further reduced and shaped using FEI Helios Plasma FIB to produce an enamel specimen as small as possible. One of the sections was analysed as a control and the second one was irradiated with a non-contact Er: YAG laser (2940 nm, 100 mJ, 15 Hz, at 2 mm distance from the surface of dentine) for 30 s, in a moist environment. Samples were analysed using both FEI Quanta 200 SEM and Zeiss Xradia 810 Ultra.
Result: Under the nano-CT, the lased enamel surface possesses a characteristic 'rough' morphology, with surface roughness on the scale of 1–5 µm. There appears to be a very little subsurface damage, the prismatic structure appears to still extend up to the surface although there is some evidence of a denser surface within the top few hundred nanometres. SEM showed a smooth surface of control enamel, whereas in lased one, the prismatic structure expressed some flat glazed area.
Conclusion: Ultra-high resolution X-ray nanotomography has been shown to be a new powerful technique for investigating the three dimensional structures non-destructively.
Keywords: Enamel, Er: YAG laser, Nanotomography, FEI Quanta 200 SEM

POSTER #19

Effects of Sterilisation and Storage on Dentine mechanical properties

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Objective : Extracted teeth are used for pre-clinical teaching, dental materials researches, and transplantation. They are considered to pose a biological hazard, and a potential cause of cross infection. Therefore, proper sterilisation and storage are important. However, these procedures might alter the dentine mechanical properties, which can greatly affect the research outcomes. The objective of this work is to investigate influence of different sterilisation and storage methods on the dentine microhardness, root susceptibility to vertical fracture, and push-out bond strength to biodentine cement.
Methods: Eighty-four extracted mandibular premolars collected under NHS ethical approval (15/LO/1545), were randomly allocated to seven groups: (i) one cycle autoclaving, (ii) two cycle autoclaving, (iii) formalin, (iv) chloramine, (v) distilled water, (vi) frozen, (vii) control (freshly extracted teeth). After the assigned treatment, dentine discs of 2mm thickness were prepared from crown of each premolar and prepared for microhardness measurement. The pulp space of each disc was prepared to be filled with biodentine for pushout bond strength analysis. Each remaining root was then subjected to vertical loading, and maximum force at fracture (F-max) was recorded.
Results: In comparison to the hardness of control samples (61.8), independent sample t test ($P > 0.05$) reveals significant reduction in the autoclaved (53.3), water stored (56.2) and frozen samples (58.5). However, no significant effect for sterilisation and storage on the pushout bond strength which is 11.3 in the control group, and F-max of vertical root fracture (526.1) except for two cycle autoclaving (8.5 and 413.21 respectively).
Conclusions: Autoclaving, water storage and freezing significantly decreased the dentine microhardness. However, two cycle autoclaving affected the root susceptibility to fracture, and push-out bond strength.

POSTER #20

Effect of Water Storage on Physico-mechanical Properties of Dental Hybrid Ceramics

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Introduction: Dental hybrid ceramics have been developed to provide better mechanical properties, lower discoloration rates, and higher wear resistance than the conventional resin composites. They are currently available as monolithic blocks fabricated for CAD/CAM systems. However, little is known on their mechanical behaviours under simulated oral conditions.
Objectives: To analyse the surface topography of five CAD/CAM materials using scanning electron microscopy (SEM); to investigate and compare hardness obtained via nanoindentation and microindentation measurements; and to explore the changes of hardness and modulus subjected to aging.
Materials & Methods: 25 bar shaped specimens (12x4x2 mm) were prepared from five CAD/CAM blocks. The surface morphology of the tested ceramics was studied by SEM. Micro-hardness of the specimens was measured using Vicker indenter under a load of 100 gf for 10 s at room temperature. Nano-hardness was tested under 50 gf with a 10 s pause/dwell. After recording the baseline data, specimens were stored in distilled water at 37º C for 30 days before taking the 2^{nd} measurements.
Results: The nano-hardness mean values of the studied materials ranged from 0.32 to 7.05 GPa. For the micro-hardness, the mean values ranged from 25.82 to 499.92 HV. Elastic modulus mean values ranged from 4.66 to 76.40 GPa. Statistically significant differences were found between the tested materials for all the studied mechanical properties. A statistical significant difference was also noticed before and after water storage for dental hybrid ceramic group. Positive correlations (r^2=0.56) between the amount of ceramics and hardness values in both micro-hardness and nano-hardness data were noticed.
Conclusions: Different CAD/CAM materials show different surface morphology with fillers in different size, shape and density. Micro hardness and nano hardness of the studied materials increased systematically with an increase in filler loading. Mechanical properties of dental hybrid ceramic significantly decreased after 30 days of water storage.

POSTER #21

Products Formed after SDF Application under Carious and Erosive Conditions

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Objectives: To investigate the products formed after topical application of SDF (Silver diammine Fluoride) and its componenets (Ag and F) under erosive (pH 4.0) and carious (pH 5.0) conditions.
Methods: There were eight experimental groups, including NaF Tx under pH 5.0, AgF Tx under pH 5.0, $AgNO_3$ Tx under pH 5.0, SDF Tx under pH 5.0, NaF Tx under pH 4.0, AgF Tx under pH 4.0, $AgNO_3$ Tx under pH 4.0 and SDF Tx under pH 4.0. All reagents were at a concentration of 3.16 M aqueous solution. For each group, 0.5 g of un-sintered hydroxyapatite powders (Plasma Biotal Ltd) was mixed with 6 mL of application agents. The treated groups were then exposed to dilute acetic acid at pH 5.0 or pH 4.0. Subsequently, these treated powder samples were placed in a desiccator for three days. Thereafter, ^{19}F and ^{31}P MAS-NMR (Magic Spinning Angle – Nuclear Magnetic Resonance) were used to study the products formed after treatments and after acid challenges.
Results: Fluorapatite was the main product found in NaF Tx whereas Ag_3PO_4 was the main product found after $AgNO_3$ Tx. Both CaF_2 and Ag_3PO_4 were detected in groups of AgF Tx and SDF Tx. An increase amount of reaction products was found at pH 4.0.
Conclusions: CaF_2 and Ag_3PO_4 were two major products formed after application of SDF. pH has an effect on the amount of reaction products formed.

POSTER #22

Novel Biofabrication Based on Directed Biomineralization

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Introduction: The field of biofabrication holds great promise for a variety of medical applications in tissue engineering and regenerative medicine. Biofabrication occurs mostly around restricted corners on organic matrices, therefore, developing a novel bottom-up biofabrication strategy based on directed biomineralization of hydroxyapatite (HAp) by controlling organic/inorganic molecular interactions may help to control the assembly, directionality, morphology and even the structure hierarchy of the single crystal phase.
Objectives: To develop a new biofabrication process based on controlled biomineralization. Our approach combines a biomineralizing organic matrix and structural features that guide crystal growth with high spatiotemporal control.
Methods: The ELP (Elastin-like peptides) membranes were synthesized on PDMS (Polydimethylsiloxane) moulds with different micro topographies. By dissolving ELP molecules in the solvent with DMF (Dimethylformamide) and DMSO (Dimethyl sulfoxide) at ratio of 9:1, the ELPs were crosslinked with HDI (Hexamethylene diisocyanate) in a glovebox with the humidity below 25. Finally the membranes were placed inside HAp mineralization solution ($pH \approx 6$) and kept in an incubator (37 °C) for 8 days.
Results: ELP membranes were successfully fabricated with precise microtopographies. Upon exposure to the mineralization solution, symmetric round shaped hierarchically ordered HAp nanocrystalline structures were formed. These structures resemble that of human dental enamel. The surface microtopographies affected the growth of the mineral. The HAp nanocrystals grow along the edge of the polygon topographies, down inside the holes and over the posts which promotes the nanocrystals growing towards two perpendicular directions. With a limited growing space, the nanocrystals were aligned straight along the microchannels.
Conclusion: A topographically patterned organic matrix has the potential to direct the growth of nanocrystals in reproducible fashion. This study demonstrates the possibility to guide biomineralization into complex architectures and opens the possibility to build more complex mineralized tissues by design.
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POSTER #23

Translucency of Zirconia Ceramics Before and After Artificial Aging

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Objective: Application of monolithic zirconia restoration is rising in dentistry. The manufacturers continuously improve their translucency. A known disadvantage is the ageing of zirconia ceramics (Y-TZP), which is related with tetragonal to monoclinic phase transformation. This microstructural change may affect the optical properties of the Y –TZP ceramic. This study examines the effect of aging on the translucency of different zirconia materials.
Methods: 120 disc-shaped specimens (diameter 13.75 mm, thickness 0.5 mm) were milled from four zirconia materials: Cercon ht white, BruxZir Solid Zirconia, Zenostar T0, Lava Plus (n = 30 per group) and sintered according to manufacturer`s recommendation. The CIELab coordinates (L*, a*, b*) and reflectance values (Y) were measured using a spectrophotometer before and after ageing. The accelerated aging was performed according to ISO 13356:2015 in a steam autoclave (134°C, 0.2 MPa, 5 hours). The contrast ratio (CR) and translucency parameter (TP) were calculated from the L*, a*, b* and Y values, according to following formulas CR = Yb/Yw and TP = $[(L^*_b - L^*_w)^2 + (a^*_b - a^*_w)^2 + (b^*_b - b^*_w)^2]^{1/2}$. The General Linear Model (Bonferroni adjusted) was used to compare both parameters before and after aging ($p < 0.05$).
Results: The CR and TP differed significantly before and after aging in all groups tested. Before aging, Zenostar T showed the highest and Lava Plus showed the lowest translucency. After aging, Cercon ht and Zenostar T showed the highest and BruxZir and Lava Plus the lowest translucency.
Conclusions: The ageing process can influence the translucency and thus the esthetic outcome of zirconia restorations. Nevertheless, the differences are below the detectability threshold of the human eye.
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POSTER #24

Effect of pH on Strength and Fluoride Release of GICs

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Objectives: To evaluate the effect of pH on flexural strength and fluoride release from glass ionomer cement (GIC).
Methods: The GIC tested was a self-setting product (GC Fuji IX GP Extra). Specimens 2x2x25 mm were made in molds after mixing according to the instructions. After curing (24 h at 37 °C, 100 % RH) the specimens were placed in borosilicate tubes containing 4 ml of 1 mM TRIS-buffer solution with pH 4, 6 and 7 for 7 days. Thereafter, the specimens were tested in a three-point deflection jig at a speed of 0.75 mm/min. The concentration of fluoride in the solutions was measured by a fluoride selective electrode.
Results: Fluoride release was increased after lower pH exposure; 4 mg/l, 11.6 mg/l and 18.2 mg/l for solutions with pH values of 7, 6 and 4, respectively. Although a slight decrease in the mean flexural strength values was observed with decreasing pH, the differences were not statistically significant ($p \geq 0.5$); (pH 4: mean 14 MPa (SD 4.9); pH 6: mean 16 MPa (SD 3.6); pH 7: mean 17 MPa (SD 6.1)).
Conclusion: The fluoride release from GIC was dependent on the pH of the surrounding moisture and highest at low pH. Different pH did not influence significantly the mechanical strength during the time span of this study. The effects may have implications in a clinical setting.

POSTER #25

High Entropy Alloy with Superior Characteristics for Dental Applications

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Introduction: High Entropy Alloy (HEA) represents a new concept of metallic materials that contains 5 or more elements, in proportions from 5 to 35 at. %, and forms simple solid solutions (BCC and/or FCC) instead of complicated intermetallic phases. These specific features provide HEA with excellent mechanical properties (hardness, strength, malleability), oxidation and corrosion resistance, with potential applications including biomedical industry. The present tendency in the newest titanium alloys generation for medical use is the decrease of elasticity modulus, with the maintaining of high mechanical characteristics.
Objective: The objective of the present paper was the obtaining of new HEA TiZrxNbyTaFe (x = 10-20 at.%, y = 20-30at.%) with higher physical-chemical, structural and mechanical characteristics than the existing biomedical alloys.
Methods: Two methods have been used for alloys synthesis: melting/casting in induction furnace under vacuum/inert atmosphere and mechanical alloying/pressing/sintering. The obtained alloys samples were investigated for structural/mechanical characterizations and corrosion resistance as well.
Results: The new alloys exhibited superior mechanical resistance comparing to titanium alloys by 10%, low density (6,7 g/cm^3) while the elasticity modulus decreased by 4%. The corrosion resistance of the high entropy alloys is comparable to other biomedical alloys.
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POSTER #26

A Novel Scaffold Fabrication Technique via Gas Foaming for Craniofacial Regeneration

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Objective: To fabricate porous hydroxyapatite scaffolds using a novel gas foaming technique.
Materials and Methods: Baker's yeast is used as the novel gas foaming agent. Yeast generates gas as it consumes sugar in optimum temperature environment. The filler includes grounded particles of plain wheat flour, sugar and Hydroxyapatite (Plasma Biotal) being used as bioactive ingredient. The addition of yeast/lukewarm water suspension into the filler gives a doughy appearance which is loaded onto a mechanical extruder to get shaped scaffolds. Scaffolds were sintered at different temperatures for 4 hours in Carbolite® furnace to get densified scaffolds. Physical characterization of scaffolds was carried out by scanning electron microscopy (SEM). Fourier Transform Infrared (FTIR) spectroscopy assessed chemical characteristics. X-ray diffractometry (XRD) evaluated the effect of sintering temperature on scaffolds.
Results and Discussion: Porous HA scaffolds were successfully fabricated, the SEM images showed interconnected network of porosity in different samples. The texture appears to be rough and smooth. Pore size ranges between 4 µm to 28 µm. FTIR spectrum findings demonstrates peak at 3570 cm^{-1} which indicates the presence of Hydroxyl band in HA, peak at 1454 cm^{-1} is indicative of carbonate bands. The v_3 Phosphate band vibrations are visible at 1085 cm^{-1} confirming the presence of HA after sintering. XRD spectra narrate narrow diffraction lines indicating the sample to be crystalline in nature.
Conclusion: This study demonstrated a novel method of porous HA scaffold fabrication. Physical and chemical finding suggest that this method can be used in craniofacial tissue regeneration and is subjected to further optimization.

POSTER #27

Effect of Micro Retentive Groove for Bond Strength.

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Objectives: The bond strength is configured from chemical adhesion and mechanical interlocking. We especially focused on the mechanical interlocking to improve the total bond strength for CAD/CAM fixed prosthetic. On the other hands, the novel processing of crown inner surface using CAD/CAM was projected to shape deliberate groove (Micro Retentive Groove: MRG). The purpose of this study was to evaluate the effect of MRG shaping process on the pull-out bond strength of a self-adhesive resin cement to CAD/CAM resin composite crown.
Methods: Standard master model was designed with a height of 3.5mm, diameter of 6mm, 1.0mm round marginal finish line, 6 degrees for each axial wall of the model. MRG depth was designed with 0, 25, 50, 75, 100 µm. Seventy five CAD/CAM composite blocks (CERASMART, GC) were divided into fifteen groups (0, 25, 50, 75, 100µm MRG/ 0, 20, 40µm cement space), and were milled by using GN-1000 (GC). The resin composite crowns without MRG were sandblasted before bonding procedure, and self-adhesive resin composite cement was used as a bonding material. After water storage at 37°C for 24h, the specimens were submitted to a pull-out bond strength test. Specimens were loaded to failure in a universal testing machine, and the data was analyzed with one-way ANOVA (a=.05).
Results: The highest pull-out bond strength in MRG groups was achieved at 100/40 (9.2±1.0MPa), whereas the lowest bond strength value was recorded in 25/40 (4.6±2.1MPa). One-way ANOVA revealed that process of MRG showed significant differences between the bond strength to CAD/CAM resin composite crown.
Conclusions: Within the limits of the study, it may be concluded that shaped of MRG increased bond strength of CAD/CAM resin composite crown. Combination of 100µm groove and 40µm cement space generated the highest bond strength among the groove processed methods.

POSTER #28

Fitting quality of CAD/CAM Crown Fabricated from Different Cement Thickness

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Objectives: The quality of marginal and internal fit of crown is important factor for clinical longevity. The influence of different cement thickness for the fitting of CAD/CAM composite crowns has not been checked. The aim of this study was to assess the fitting of the CAD/CAM composite crown fabricated from different parameter settings of cement thickness.
Methods: After scanning the master die using an extraoral scanner (D810, 3Shape), CAD/CAM composite crown was designed using the CAD software (Dental Designer, 3Shape). The crown models were designed with a cement thickness of 0 µm at the margin, and 0, 30, 60, 90, 120 µm at the axial wall and occlusal area. The thickness of the crown was set as 1.0 mm. For each designs, a total of six crowns were fabricated using a milling machine (Mill LW-1, GC), and CAD/CAM composite block (Cerasmart, GC). The marginal and internal fit of the CAD/CAM composite crowns were checked by the replica technique. The measuring points were as follows: margin (A, B, M, N), axial wall (C, D, E, F, I, J, K, L), and occlusal area (G, H). Replica film thickness was measured with a digital microscope (VHX-200, Keyence) at a 50X magnification. The data were analyzed using a one-way ANOVA and Tukey test ($p<0.05$).
Results: The comparison of discrepancy on cement thickness between setting value of parameter and fabricated crowns, 0 and 30 µm showed significant difference at the margin and occlusal area. The other cement thickness crowns did not show significant differences on the margin and occlusal area. At the axial wall, all parameter settings showed well-fitting except at parameter set at 0 µm.
Conclusions: The quality of marginal and internal fit on CAD/CAM composite crown was affected by the parameter settings of cement thickness.

POSTER #29

Biodentine Cervical Pulpotomy in Cariously Exposed Permanent Teeth: Preliminary Results

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Objectives: To assess the outcome of biodentine cervical pulpotomy in mature permanent teeth with carious exposure.
Methods: Eighty-five permanent molar teeth with symptomatic vital pulps in 71 patients aged 9-56 years were included in the study. Preoperative pulpal and periapical diagnosis was established. After informed consent the offending tooth was anesthetized, isolated via rubber dam and disinfected with 5% NaOCl before caries excavation; subsequently the pulp was amputated to the level of canal orifices. Haemostasis was achieved and 3mm layer of Biodentine (Septodont, France) was placed as pulpotomy agent, RMGIC liner was placed and the tooth was permanently restored with either resin composite or amalgam, and a postoperative periapical radiograph was taken. Follow-up was done at 3 and 6 months.
Results: A clinical diagnosis of irreversible pulpitis was established in all teeth, and periapical rarefaction was present in 6 teeth (PAI >3). All cases attended the 3 months recall and were considered clinically successful except one tooth that had non-restorable tooth fracture, at 6 months one patient declined recall because of pregnancy. All cases were clinically and radiographically successful, cases with periapical rarefaction showed improvement in the PAI score and immature roots showed continued development. Dentine bridge formation was radiographically discernable in 5 cases and canal narrowing in 2 cases.
Conclusion: Preliminary data indicates that Biodentine cervical pulpotomy appears to be promising for cariously exposed pulps with clinical signs and symptoms indicative of irreversible pulpitis. The cases are scheduled for a yearly follow-up.
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POSTER #30

Failure Analyses of Fractured Zirconia Implant-based Restorations

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Objectives: Promising results from clinical trials with dental zirconia have inspired to more extensive use of zirconia as a dental material. The applications have extended to implant abutments and complex individually designed crown-abutment one-piece structures. Little is known about their clinical success and the primary cause of failures.
The aim of this study was to identify the cause of fracture of retrieved implant-retained one-piece restorations that failed during clinical use.
Methods: Eight fractured restorations were analyzed with fractographic methods and their fracture origins were identified.
Results: All but one of the restorations had fractures that originated in an area of high contact stress between the implant or titanium screw and the abutment base. Results of the evaluation showed that zirconia-based implant restorations with very thin walls in the region connecting the prosthesis to the implant are vulnerable to damage and fracture from the screw retaining process and from non-axial loads. The titanium screw can create severe chips in the internal surface leading to catastrophic failures.
Conclusion: The findings suggest that large crowns on narrow implants or implants with internal fixation should preferably not be made with zirconia abutments, or that a new design approach should be considered.

POSTER #31

Hardness and Specific Wear Resistance of Hydrogen Plasma Treated PMMA

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Objectives: The study aimed to evaluate the effect of hydrogen plasma treated poly propylene fibre reinforcement on the Vickers hardness and the specific wear rate of the Poly Methyl Methacrylate (PMMA) polymer composite.
Materials and Methods: Control group prepared using Poly Methyl Methacrylate polymer and test groups were prepared using PMMA polymer reinforced with hydrogen plasma treated polypropylene fibre. Hardness measured using Vickers Hardness number test apparatus having square based diamond pyramid indenter. Wear analysis measured using Pin on disc method by wear and friction monitor TR-20ICL. Microstructure of the abraded surface observed through Trinocular inverted metallurgical microscope model MetjiM1004.
Results: Detailed statistical analysis performed for the obtained results using One – Way Anova followed by Tukey- Kramer multiple comparison test. Test groups showed significant increase in hardness value and wear resistance compare to control group. Among the fibre reinforced test groups, 3mm long fibre reinforced in 10Wt% gave superior Vickers hardness number (59.7 $\pm$ 1.98) and specific wear rate (1.35×10^{-7} g/NM for 1000gm load and no wear observed for 500 gm and 300gm load)
Conclusion: Hydrogen plasma treatment on polypropylene fibre found as an effective method in enhancing the hardness and wear resistance in poly propylene fibre reinforced PMMA polymer composite. Wear resistance was inversely related to the applied load. Fibre weight percentage and aspect ratio played a significant role on Vickers hardness number and wear resistance.

POSTER #32

Environmentally Triggered Smart Biomaterials for Disease Modulation

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Objective: Currently, the prevention and management of dental disease use nonspecific approaches (e.g mechanical distruption or short term disinfection), which fail to prevent such transitions and future recurrences. The development of environmentally triggered smart biomaterials that can deliver antimicrobial and/or anti-inflammatory products for targeted interventions to control biofilm composition may lead to favourable downstream consequences in community metabolism, which may impact the genesis and progression of disease.
Methods and Materials: Neutrophil elastase (NE) responsive peptides were synthesised using solid-phase peptide synthesis with the following sequences: P1 (Suc-AAPV-NH_2), P2 (Suc-CAAPV-NH_2), P3 (Suc-CAAPVC-NH_2), P4 (Ac-CEAAPVEC-NH_2), P5 (Ac-ECAAPVCE-NH_2), P6 (Ac-EECAAPVCEE-NH_2) and P7 (Ac-EEECAAPVCEEE-NH_2). P1-P3 contained a solubilizing moiety (Suc) and P4-P7 contained the moiety (Ac) and glutamic acids (E). P2 contained one cysteine to mimic N-acetylcysteine (NAC) and P3-P7 incorporated two cysteines on either side of the NE cleavable sequence. Isolated peptides were characterised by mass spectrometry, HPLC and NMR. Antioxidant assays and enzymatic degradation assays were performed and compared to internal standards. Polyion complex (PIC) nanoparticles were prepared at N:COOH ratios of 1:5 to 1:0.2 (defined as the ratio between amines in chlorhexidine and carboxylic acids in the peptides). PIC samples were analysed using Dynamic Light Scattering (DLS) and ζ-potential (Malvern, UK) to assess formation and stability. Enzymatic degradation assays were also performed on PIC samples.
Results: P1 showed no antioxidant activity since it lacks cysteine residues. Increasing the number of cysteine residues increased the antioxidant activity (i.e. P3>P2) although these were lower than when compared with NAC. The enzyme degradation assays showed that the degradation of the peptides in the presence of NE was dependent upon the location of the cysteine residue. No degradation was observed in P1 and P2. Peptides P3-P7 degraded in the presence of NE in the order of P5-P7>P3>P4 and P6-P7 also degraded in the presence of pseudomonas aeruginosa elastase. P5 constituted the lead candidate peptide in terms of enzyme degradation and was utilised for PIC nanoparticles synthesis where particle formation was observed at N:COOH ratio of 1:0.3. PIC nanoparticles also degraded in the presence of NE.
Conclusion: The data demonstrated the ability to develop novel enzyme responsive materials that can have anti-inflammatory and antimicrobial properties for targeted interventions. Such materials may be used to control oral biofilm composition and to modulate oral disease.

POSTER #33

The Direct and Indirect Effects of Near-UV to Near-infrared Light on Wound Related Pathogens *in vitro*

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Objective: Low-level light therapy (LLLT) has been successfully applied in a range of healthcare fields for therapeutic purposes. This includes photodissinfection (~400nm) and photobiomdulation (~600-1000nm) which are both thermally independent. However, there exists limited information on what light parameters are effective for any given therapeutic application. This study aims to assess the direct and indirect effects of near-ultraviolet (N-UV) to near-infrared (N-IR) light on wound related bacteria and to determine the optimum conditions for *in vitro* photodisinfection.
Methods and Materials: Overnight bacterial cultures of *Staphylococcus aureus* (SA; NCTC 8319) and *Pseudomonas aeruginosa (*PA; NCTC 10662) were suspended in nutrient broth and plated at 10^3 CFU/ml in black clear bottom 96-well plates. The culture plates were immediately placed directly above a bespoke LED array and were irradiated at 150mW/cm^2 using specific wavelengths at a range of exposure times to deliver radiant exposures of 9-180J/cm^2. Following irradiation, plates were incubated for 24h at 37ºC. Optical density at 600nm (OD_{600}) was determined using a microplate reader (ELx800 Universal Microplate reader, BioTek Instruments, UK) following the incubation. A non-irradiated (n=-6) group was used as a control to comparatively assess the effects of irradiation. In addition, nutrient broth suspensions were irradiated without bacterial inoculation with a radiant exposure of 180J/cm^2 in order to assess any indirect effects of irradiation. Following irradiation, the broth solutions were immediately inoculated with bacteria suspensions and incubated for 24h (37ºC) before OD_{600} was measured. Statistical differences were assessed using one-way analysis of variance (ANOVA) and Holm-Sidak pairwise tests ($P<0.05$).
Results: The one way ANOVA and post hoc Tukey tests revealed bacteria specific effects of wavelength and radiant exposure ($P<0.05$). For SA, a significant reduction in optical density was measured with radiant exposures >108J/cm^2 for all the wavelengths tested. However, for PA, radiant exposures >90J/cm^2 were only effective at 395nm. Pre-irradiation of nutrient broth completely inhibited SA growth at 395nm but only partially inhibited PA growth at 395nm and 450nm for 180J/cm^2 radiant exposures.
Conclusion: Specific wavelengths of near-UV to near-IR light can reduce the growth of SA and PA in broth, particularly light at 395nm at exposures >90J/cm2. However, the effects measured following the pre-irradiation of broth suggests a synergistic effect of nutrient depletion *in vitro* which warrants further investigation.

POSTER #34

Oxidative Stress Induced by Titanium Implants

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Objectives: Nanoparticles of titanium dioxide intra-articular administered can cause oxidative stress, initiate inflammation, fibrosis, or can have genotoxicity.
The present study aim is the detection of oxidative stress after the introduction in the coxal - femoral joint an implant of titanium. Oxidative stress has been demonstrated by assessing the catalase enzyme.
Methods: The experiment was conducted on two groups of guinea pigs. Lot 1 is the control group, and group 2 is the group which has a screw of titanium dioxide with a diameter of 4.0 mm, intra-articular introduced. The study was conducted in accordance with rules for the use of laboratory animals in the Sanitary Veterinary and Food Safety Direction of Brasov, Romania. Surgery was performed after anaesthesia ip with 30 mg / kg sodium pentobarbital (Abbott Laboratories – USA). After 120 days from the introduction of the titanium screws, blood was collected for the detection of catalase enzyme activity. For detection of catalase enzyme activity was used Calbiochem ® - Catalase Assay Kit
Results: The results were statistically analysed using MedCalc Statistical Software Program. For guinea pigs group with intraarticular titanium implant, the enzymatic activity of catalase has values of 0.158 ± 3.779 nmol/min/ml; in the control group values enzyme activity, catalase were 4.84 ± 0.14 nmol/min/ml.
Conclusions: From studies in this research, results that titanium can induce oxidative stress. It is noted in the group - guinea pig which has a titanium screw introduced in the coxal-femoral joint, catalase enzyme activity is lower with 21.93% as compared with the control group.
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Poster #35

Bonding of High-Viscosity Glass-Ionomer Cements Using Light- Self-Cure Mode Adhesive Systems

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Objectives: Despite of the success rate of the high-viscosity glass-ionomer cements (HVGICs) used for Atraumatic Restorative Treatment (ART) restorations; partial or bulk fracture of the proximal part was recorded to be one of the main causes of proximal restoration failures. Yet, repair of these versions of restorative materials could be a conservative key even in cases where there is lack of electricity. Thus, present study was carried out to evaluate the repair microshear bond strength (μSBS) of three HVGICs using adhesive systems with different curing modes (light- versus self-curing mode).
Methods and Materials: A total of 54 discs (20mm diameter and 2mm thickness) of the three tested HVGICs GC; Fuji IX GP Fast HVGIC capsules, Fuji IX GP glass-ionomer cement containing chlorhexidine and ChemFil Rock zinc-reinforced HVGIC were prepared.
Each HVGIC disc was divided horizontally into three equal parts according to the repair adhesive system curing mode; Clearfil SE Bond 2 (two-step, self-etch adhesive) in light-cure mode or Clearfil Universal Bond (single-step, self-etch adhesive) in light-cure mode or Clearfil Universal Bond (single-step, self-etch adhesive) in self-cure mode after mixing with Clearfil DC Activator. A dual cure Clearfil DC core Plus (Automix) was used as a repair material. Six microcylinders were bonded to each HVGIC disc using starch tubes, two microcyliders for each one-third ending up with 36 microcylinders for each adhesive system for each HVGIC type. Bonded discs were stored in artificial saliva at 37^{o}C incubator for 24 hours. The μSBS test was conducted using a universal testing machine and failure modes were determined using scanning electron microscope. Data were statistically analyzed using two-way analysis of variance (ANOVA) with repeated measures, one-way ANOVA, and Bonferroni post hoc tests ($p \leq 0.05$).
Results: Two-way ANOVA revealed a statistical significant effect for the adhesives systems ($P<0.01$) and not for the HVGICs ($P=0.05$) and their interactions ($P=0.99$).
Where Clearfil SE and Clearfil Universal light cure mode, recorded significantly higher μSBS values than Clearfil Universal self mode.
Conclusions: The three tested HVGICs could be successfully repaired with two-step/single-step self-etch adhesive systems. Single-step self-etch adhesive system in light-cure mode is preferred than self-cure mode.

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