Dental Materials

Resin based composite and litium disylicate materials in Class II adhesive restorations

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Aim: To study the influence of resin based and lithium disilicate materials on the stress and strain distributions in adhesive class II mesio-occlusal-distal (MOD) restorations using numerical finite element analysis (FEA).
Methods: One 3D model of a sound lower molar and three 3D class II MOD cavity models with 95° cavity-margin-angle shapes were modeled. Different material combinations were simulated: model A, with a 10 µm thick resin bonding layer and a resin composite bulk filling material; model B, with a 70 µm resin cement with an indirect CAD-CAM resin composite inlay; model C, with a 70 µm thick resin cement with an indirect lithium disilicate machinable inlay. To simulate polymerization shrinkage effects in the adhesive layers and bulk fill composite, the thermal expansion approach was used. Shell elements were employed for representing the adhesive layers. 3D solid CTETRA elements with four grid points were employed for modelling the food bolus and tooth. Slide-type contact elements were used between the tooth surface and food. A vertical occlusal load of 600 N was applied, while assigning fixed zero-displacements on the cutting surfaces below the crevices. All the materials were assumed to be isotropic and elastic and a static linear analysis was performed.
Results: Displacements were different in Models A, B and C. Polymerization shrinkage hardly affected model A and mastication only partially affected mechanical behavior. Shrinkage stress peaks were mainly located marginally along the enamel-restoration interface at occlusal and mesio-distal sites. However, at the internal dentinal walls, stress distributions were critical with the highest maximum stresses concentrated in the proximal boxes. In models B and C, shrinkage stress was only produced by the 70 µm thick resin layer, but the magnitudes depended on the Young's modulus (E) of the inlay materials. Model B mastication behavior (with E= 20 GPa) was similar to the sound tooth stress relief pattern. Model B internally showed differences from the sound tooth model but reduced maximum stresses than model A and partially than model C. Model C (with E= 70 GPa) behaved similarly to model B with well redistributed stresses at the occlusal margins and at the lateral sides with higher stress concentrations in the proximal boxes. Both simulation showed a far behaviour from a failure condition.
Conclusions: Loading and polymerization shrinkage differently affected the stress distribution. Class II MOD direct resin composite showed greater potential for damage because of higher internal and marginal stress evolution during resin polymerization shrinkage. With a large class II MOD cavity an indirect composite or a lithium disilicate inlay restoration may provide a mechanical response close to sound tooth one.

Wear behaviour in thin, occlusal, composite overlays with CAD-CAM system

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Aim: A mini-invasive preparation of tooth surface is necessarily to rehabilitate patients with moderate wear lesions. Thin, posterior occlusion restorations represent a conservative alternative to complete coverage crown. The aim of this in vitro study was to evaluate the mechanical and wear behavior of ultra-thin (<1mm) CAD-CAM composite occlusal veneers. The tested hypothesis was that resin thickness influences the mechanical and marginal stability of composite overlays.
Methods: Eight (n=8) caries-free, extracted human molars were collected. Occlusal surface of teeth was covered with powder (Optispray Cerec, Dentsply-Sirona) and scanned (Cerec Bluecam, Dentsply-Sirona). Specimens were prepared to simulate a moderate occlusion wear: enamel was reduced, maintaining a cuspal inclination using diamond burs, dentin was exposed and immediate dentin sealing (IDS) protocol was performed with phosphoric acid selective enamel etching (Ultra-Etch, Ultradent) followed by Scotchbond Universal Adhesive (3M ESPE) applied in accordance with manufacturer's instructions, self-etch mode. Specimens were then covered with powder (Optispray Cerec, Dentsply-Sirona) and re-scanned using Cerec Bluecam (Dentsply-Sirona), then restorations were realized with Cerec Software 4.4.2 and milled from composite resin blocks (Lava Ultimate Restorative, 3M ESPE). Two different thicknesses were evaluated: 0,5 mm and 0,8 mm measured at the central pit. Both tooth surface and restoration were sandblasted and luted with Scotchbond Universal Adhesive (3M ESPE) and TetricEvoFlow (Ivoclair-Vivadent). Photo-polymerization was performed with an LED lamp (Valo, Ultradent) for 60 sec on each surface. Silicon and digital impressions of samples were detected to allow surface analysis with SEM. A chewing simulator (Mechatronic) was used to simulate occlusal loading. Specimens were submitted to a thermal-cyclic load of 50 N at a frequency of 5 Hz for 1.200.000 cycles. Digital and silicon impression were taken after loading too. SEM analysis was performed using epoxy resin replicas before and after loading to assess the mechanical performance wear patterns and marginal quality of interfaces.
Results: SEM analysis showed defined substance wear areas in the contact point area. Continuous margin adaptation at the interfaces showed no differences in both groups.
Conclusions: The results of the present study support the hypothesis that both 0.5 and 0.8mm thick composite overlays effectively maintain good marginal integrity after thermal-cyclic occlusal load. Additional studies are currently ongoing to test the longevity of composite overlays.

FEM and von Mises analysis on prosthetic crowns structural elements: evaluation of different applied materials

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Aim: There is a level of stress, defined as the tolerance limit, below which a biomaterial can be loaded indefinitely, that is, the structure can withstand a number of repeated load cycles over time without there being any failure by fatigue. The aim of this paper is to underline the mechanical properties of dental single crown prosthodontics materials in order to differentiate the possibility of using each material for typical clinical condition and masticatory load. Objective of the investigation is to highlight the stress distribution over different common dental crowns by using computer-aided design software and a three-dimensional virtual model. In this study the biomechanical behavior of prosthetics dental crowns subjected to static loads in contact with the jawbone have been highlighted.
Methods: By using engineering systems of analyses like FEM and Von Mises investigations it has been highlighted the strength over simulated lower first premolar crowns made by chrome cobalt alloy, golden alloy, dental resin and with zirconia. The tooth used in this study comes from a scan of a real M1 tooth. The scanning file was constituted by a cloud of points and provided information about the surface of the body and not about its internal composition. The recomposition of the material stratification that defines the tooth was processed in environment cad. The intermediate and superficial layers of the tooth, were obtained through scaling and subtraction Boolean operations carried out in sequence; the layer of enamel thus obtained is changed from 0.9 mm to 0.3 mm (the minimum thickness is recorded on the end of the tooth), while the dentin has a thickness ranging between 1.21 mm and 0.5 mm. The prosthodontics crown models have been created and put on simulated chewing stresses. The three dimensional models were subjected to axial and oblique forces and both guaranteed expected results over simulated masticatory cycle. Dental resin presented the low value of fracture while high values have been recorded for the metal alloy and zirconia.
Results: The FEM analysis carried out on the tooth modeled with natural materials was performed in the same conditions described above; although for this specific case the constraint configuration can not be considered as realistic, it was assumed that, in order to have a reliable comparison with the models made

of biomaterials, the constrain configurations should be the same.
Conclusions: Clinicians should choose the better prosthetic solution for the teeth they want to restore and replace. Both prosthetic dental crowns offer long-term success if applied following the manufacture guide limitations and suggestions.

A long-term clinical performance of aesthetic restorative composite material

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Aim: Over the last two decades, due to the increasing attention to aesthetics, the field of cosmetic dentistry has considerably developed. Therefore, various restoration materials and application techniques have been developed to improve as well clinical longevity as aesthetics of restoration materials. On the one hand, it has been developed nanotechnology which consists in the production of materials in the range from 0.1 to 100 nanometers through various physical and chemical methods. The application of nanotechnology to dentistry has enabled the incorporation of a large amount of small particle filling a more homogeneous distribution in the organic matrix. On the other side, it has been developed the Rapid amplified photopolymerization (RAP) that is a new catalyst technology to improve efficiency of the photopolymerization instead of conventional initiators such as camphorquinone (CQ). New materials are launched on the market and are claimed by manufacturers to benefit from better surface qualities thanks to their filler formulation, but little is known about their long-term clinical performance. The purpose of this study is to evaluate the clinical performance of a new aesthetic composite material (Estelite, Tokuyama Dental, Japan) a light-curing dental restorative composite resin which uses both nanotechnology because it uses over-spherical nano filler (82% in weight and 71% in volume of a filler consisting mainly of silica and zirconia) and the RAP Technology™.
Methods: A total of 30 (15 Class 4, 10 Class 2, 5 Class 1) lesions were restored with Estelite (Tokuyama Dental, Japan) in combination with a self-etch adhesive (Kurakay Dental). The resin was cured for 20 seconds with DENTSPLY visible light source (Dentsply LQ 75TM). All restorations were evaluated after 1 week (baseline), 6, 12 and 24 months for the following characteristics: retention, color match, interfacial staining, secondary anatomical form, marginal adaptation or integrity and surface texture using the modified United States Public Health Service (USPHS) criteria.
Results: All restorations, evaluated after 1week, 6, 12 and 24 months, showed high translucency, high polish, no trends to downgrade in anatomical form, no secondary caries, no alteration of surface texture, of marginal adaption and no discloloration.
Conclusion: Filler and organic matrix of aestetic composite material have been modified in an attempt to offer satisfactory mechanical and esthetic characteristics. ESTELITE is a composite material of high aesthetic yield, for the presence of a spherical form, mono disperdent filler mainly constituted by silica and zirconia (average particle size is 200 nm) obtained by creating cores of the filler in an organic solvent which then grow gradually to obtain a uniform and spherical shape (sol-gel method). Supra-Nano filler promotes a very smooth surface with a high degree of gloss and it is easily obtainable and long-lasting. The high percentages of the filler reduces polymerization shrinkage and offerts an excellent wear resistance. Moreover, the Radical Amplified Photopolymerization (RAP) technology provides a long time for the processing of the material under the lamp of the dental unit and a rapid photopolymerization time (1/3 of the exposure time required for conventional composite materials). It is not sticky, easy to shape, it has superior characteristics compared to other materials as regards resistance to stress and abrasion from opposing tooth. Follow-up over the time showed excellent clinical performance, satisfactory cosmetic results regard color compatibility, translucence and opalescence of the surrounding natural teeth.

Dental sealants: use of hydrophilic materials in clinical practice and in training professionals

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Aim: Hydrophilic composite resin materials are compatible with damp environments and can effectively polymerize in the presence of water without affecting the result of the restoration. They have been developed to provide the professional of healthcare a valid alternative when the use of invasive moisture insulating techniques cannot be employed since to compliance and patient comfort. The aims of this split-mouth study were: i) to provide rational indications and guidelines to use of such materials; ii) to test their strength when in an oral environment for short and long time; iii) to test the successful employment of these devices by students enrolled in the Dental Hygiene degree program, at the at the Pio Albergo Trivulzio Institute University of Milan, Italy.

Methods: 24 patients (up to 14 years of age) were selected, in which a minimum of four elements had been prepared to be sealed (at least one for hemiarch). The oral cavity was thus considered divided into two halves: the elements of the quadrants 1 and 4 were treated with hydrophobic photopolymerizable composite material. The elements in quadrants 2 and 3 are treated with hydrophilic composite light-curing Embrace Pulpdent®. The sealed elements were subjected to instantaneous control and evaluation by a dental hygienist expert, and then re-examined at 3 months.
Results: Our results demonstrate that the employment of sealants WETBOND represent the best choice when the use of waterproofing methods is not possible, therefore showing increased quality of the seals made with such materials, along with a better short-term persistence in the mouth.
Conclusions: The WETBOND composites are a good alternative to drybond materials, resulting in even better production aspects, quality, persistence and clinical convenience for experienced staff and in training personnel.

Crystal phase formation and mechanical properties of nano-engineered glass ceramics for CAD/CAM dental restorations

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Aim: The wide diffusion of chairside CAD/CAM systems for whole digital workflow restorations has lead to development of specific dental materials that include a wide range of new nano-structured glass ceramics. Mostly of the new materials are not immediately applicable after the milling procedure, since they must be heat-treated to reach a final level of crystallization for adequate mechanical and aesthetic properties. To achieve a controlled crystallization without causing deformation a precise heat treatment schedule, is provided by manufacturers. Notwithstanding this, due to the many types of dental furnaces used in dental practice and imprecise thermal calibration, many problems often occurs. The objective of his study was to define the impact of heating rate to the crystal growth of CAD/CAM glass ceramics treated in a conventional furnace.
Methods: Lithium disilicate (LS2) (IPS EMax-CAD, Ivoclar Vivadent, Schaan, Liechtenstein) and two zirconia reinforced lithium silicate ceramics (ZLS) (Vita Suprinity, VITA Zahnfabrik, Bad Sackingen, Germany; Celtra Duo, Dentsply Sirona, Salzburg, Austria) were used in the present study. The mechanical properties and the crystal growth were evaluated on 30 specimens (n=10 for each group). The LS2 specimens were heat-treated starting from 400°C until to 840°C with heat rate of 55° C/min and a hold time of 8 minutes, while the ZLS specimens were heat-treated starting from 500°C until to 820°C with heat rate of 55° C/min and a hold time of 1.30 minutes. The investigation was carried out by a means of SEM, and AFM after a slight surface etching with hydrofluoric acid solution (1%) for 20 seconds. Three additional specimens were used for Differential Thermal Analysis (DTA). DTA analysis was performed to identify the transformation temperatures for each type of material considered in the present study. Finally, all groups of specimens were tested for fracture toughness (Ft) and Vickers hardness (Hv).
Results: The mean size (± SD) of crystals after heat treatment was 1.65 (±0.34) microns for LS2, 854.5 (±155.0) nm for ZLS suprinity and 759.9 (±118.4) nm for ZLS Celtra Duo. As consequence of crystallization, the Ft was 2.2±0.1 MPa m1/2 for LS2, 4.7 ±0.8 MPa m1/2 for ZLS Suprinity and 3.8±0.6 MPa m1/2 for ZLS Celtra Duo; while, the Hv was 6.1±0.3 GPa for LS2, 7.6±0.7 GPa for ZLS Suprinity and 7.1±0.5 GPa for ZLS Celtra Duo. The DTA curves showed for LS2, ZLS Suprinity and ZLS Celtra Duo at a temperature range 400 to 500° an endotherm peak.
Conclusions: The Organization of microstructure before and after heat treatment appears to be extremely different showing the presence within the glass matrix of a multicomponent system due to nucleation process. All the CAD/CAM materials evaluated in the present study showed a crystallization process highly dependent to temperature with significant differences for both crystal size and mechanical properties.

Physical and mechanical properties of aesthetic materials used for manufacturing monolithic crowns via CAD/CAM: hardness and coefficient of friction preliminary results

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Aim: The aim of this study is to investigate different characteristics of the materials used in the monolithic dental crowns CAD-CAM realized, such as Hardness, Coefficient of Friction, Roughness, Wear Potential and Mechanical strenght.
Methods: Five materials were considered for this study: E.Max CAD (Ivoclar Vivadent); Suprinity (VITA); ENAMIC (VITA); Lava Ultimate (3M ESPE); Lava Plus

(3M ESPE). For Vickers Hardness test, five disks (12 x 2 mm) were obtained from each material. Specimens were polished with silicon carbide sandpapers (400-600-1200-grit) in a polisher (Metaserv 2000, Buehler, Buehler UK Ltd., Coventry, United Kingdom) under water irrigation. Five indentations were performed in each specimen using a Vickers diamond indenter in a micro-hardness tester (Buehler, Lake Bluff, USA) under 4.9 N load and a 20 seconds dwell time. The values were obtained in VHN. For Coefficient of Friction test, ten discs (12 x 2 mm) of each material were prepared, polished with silicon carbide sandpapers (400-600-1200-grit) in a polisher (Metaserv 2000, Buehler, Buehler UK Ltd., Coventry, United Kingdom) under water irrigation and placed on a ball-on-flat tribometer. A stainless steel ball (2 mm diameter) frictioned back and forward covering a total distance of 9,7mm for each cycle. Each specimen was hold in position by three metal "arms" that were positioned by the operator in order to hold firmly the specimen. A load of 5.0 N was applied to each specimen; test duration was 600 seconds; frequency was 5 Hz. Test was conducted at room temperature and humidity.
Results: The Vickers Hardness results showed that Lava Plus (3M ESPE) showed the statistically highest HVN values when compared with all the other materials. E.Max CAD (Ivoclar Vivadent) and Suprinity (VITA) did not show any significant difference between them, being their HVN values statistically highest than all the other materials studied except for Lava Plus (3M ESPE). Finally ENAMIC (VITA) showed hardness values higher just than Lava Ultimate (3M ESPE), which was the weakest material in terms of hardness. The coefficient of friction results showed that Lava Plus (3M ESPE) and E.Max CAD (Ivoclar Vivadent) presented the lowest Coefficient of Friction values while Lava Ultimate (3M ESPE) showed the highest values. Statistical difference was not found neither between ENAMIC (VITA), Suprinity (VITA) and Lava Ultimate (3M ESPE) nor between E.Max CAD (Ivoclar Vivadent), ENAMIC (VITA) and Suprinity (VITA). Lava Plus (3M ESPE) Coefficient of Friction values were statistically lower than all the other materials exept for E.Max CAD (Ivoclar Vivadent). Statistical evaluation was done using One-Way ANOVA test.
Conclusion: The partial results of this ongoing study are in complete accordance with literature. Nevertheless, complications during Suprinity (VITA) Hardness measurements occurred due to propagating cracks on the material surface. The next step of this study will present Roughness, Wear Potential and Mechanical Strength results of the same materials and will verify the influence of Hardness, Coefficient of Friction and Roughness on Wear Potential and investigate how different finishing surface clinical protocols can influence material Mechanical Strenght on the short and on the long time.

Solubility and pH of root canal sealers: *in vitro* study

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Aim: The most desirable physical properties for filling materials include insolubility. In fact, degradation of the sealer may cause gaps and voids along the sealer/dentin interface which might provide a pathway for microorganisms and their toxic products into periapical tissues. The pH change of sealers may be related with antimicrobial effects and deposition of mineralized tissue. The purpose of this in vitro study was to evaluate solubility at 24 hours and pH at 3 and 24 hours of different root canal sealers.
Methods: Eight root canal sealers were tested: BioRoot™ RCS, TotalFill BC Sealer, MTA Fillapex, Sealapex™, AH Plus, EasySeal, Pulp Canal Sealer™, N2. The solubility was determined in accordance with the International Standards Organization (ISO) 6876 method. Stainless steel ring molds were used for sample preparation. All moulds were weighted using a precision balance. The moulds were filled with the mixed materials. All samples were left to set in a cabinet (37˚C, > 95% relative humidity). The samples weighed and were placed in a Petri dish, containing 50 ml of distilled water. The Petri dishes were transferred in the cabinet for 24 hours. After that, the samples were rinsed with distilled water. The samples were discarded, and the Petri dishes were dried in an oven at 105 ˚C for 48 hours, cooled down in the same desiccator and reweighted. The difference between the final mass and the initial mass of the Petri dish divided by the initial dry weight of the sample x 100, correspond to the loss of mass of each specimen express as percentage of solubility. The solubility test was repeated 2 months after by using the same method. The solubility of the root canal sealers should not exceed 3 % mass fraction. pH measurement was performed 3 and 24 hours after incubation with a digital pH meter.
Results: BioRoot™RCS and TotalFill BC Sealer showed significantly higher ($P < 0.05$) solubility among the tested materials. For remnant materials analyzed fulfilled the requirements demonstrating a weight loss of less than 3%. AH Plus provided the lowest solubility. Pulp Canal Sealer™, N2, Sealapex™, EasySeal, MTA Fillapex displayed a solubility values significantly lower ($P < 0.05$) than that observed for BioRoot™RCS and TotalFill BC Sealer but significantly higher ($P < 0.05$) than AH Plus. The solubility values in increasing order were AH Plus < Pulp Canal Sealer™ < N2 < Sealapex™< EasySeal < MTA Fillapex < BioRoot™RCS < TotalFill BC Sealer. BioRoot™RCS, Totalfill BC Sealer

and Sealapex™ exhibited high alkaline pH over time. Significantly lower (P<0.05) was the alkalinity of EasySeal, MTA Fillapex, Pulp Canal Sealer™ and AH Plus. MTA Fillapex exhibited an initial neutral pH (7.68) that was followed by a weak alkaline pH (8.02). Whereas, both Pulp Canal Sealer™ and AH Plus had an initial weak alkaline pH (8.0) followed by a neutral pH (~7.6). At the end, N2 exhibited an initial neutral pH (~7.1) that followed by a final weak acidic pH (~6.98). Conclusion. The findings of this study showed that Easy Seal, MTA Fillapex, Pulp Canal Sealer, Sealapex, AH Plus and N2 fulfilled the requirements of the ISO 6876 and ANSI/ADA specification No. 57, demonstrating a weight loss of less than 3%. BioRootRCS and TotalFill BC Sealer cannot be considered accordant with the ISO Standards, because the weight loss was more than 3%.

Degree of conversion and micro-hardness of new bulk fill composites

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Aim: The aims of this study were to in vitro evaluate the degree of conversion (DC) and micromechanical properties (Vickers hardness, VH) of five different bulk-fill composites; in addition, the performance of two light-curing lamps was analysed.
Methods: The following composites were tested: FiltekTM Bulk Fill Posterior Restorative (3M, ESPE), Sonic FillTM (Kerr Corporation), Sonic Fill 2 TM (Kerr Corporation), classified as high viscosity bulk composites, and Fill Up!TM (Coltène) and SureFil® SDR® (Dentsplay) classified as low viscosity bulk composites.Samples of 4 mm x 10 mm were prepared using Teflon molds and Mylar strips filled in one increment, and then polymerized using two light-curing lamps. Ten samples for each composites were cured using Elipar S10 and 10 using Demi Ultra. The degree of conversion (DC) was determined by Raman spectroscopy, while the Vickers microhardness (VMH) was evaluated using micro-hardness tester, respectively. DC and VH measurements of the bulk fill composites were carried out on top and bottom sides, immediately after curing(t0), and, on the bottom side, after 24h (t24). Two-ways analysis of variance was used. In all analyses, the level of significance was set at p<0.05.
Results: All bulk-fill resin composites recorded satisfactory DCs on top and bottom sides. At t0, the top of SDR (85.56±9.52) and SonicFill2 (85.47±1.90) showed the highest DCs-values, when cured using EliparS10; using DemiUltra, SonicFill2 showed the highest DCs-values (90.53 ± 2.18). At t0, the highest DCs-values of bottom sides were recorded by SDR (84.64±11.68), when cured using EliparS10, and Filtek (81.52±4.14), using DemiUltra. On top sides, Demi Ultra lamp showed significant higher DCs compared to the EliparS10 (p<0.05). At t0, VMH-values ranged between 24.4 and 69.18 for EliparS10, and between 26.5 and 67.3 for DemiUltra. Using both lamps, the lowest VMH-values were shown by SDR, while the highest values by SonicFill2. At t24, all DC and VMH values significantly increased.
Conclusion: The curing lamps induced higher top DC values of the bulk-fill composites compared to the bottom values. All DC and VH measurements increased over time, reaching the highest values at 24h. Even at t0, the three high viscosity bulk-fill composites showed higher VMH than the low viscosity ones.Our upcoming aim will be to increase the number of the tested dental composites, as well as to further study by means of vibrational techniques both dental and composites surfaces after finishing and polishing.

Lasers sintered biomaterials on dentine and enamel surfaces for treating dental hypersensitivity: an *ex vivo* study

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Aim: Tooth hypersensitivity is a common condition characterized by dentinal tubules exposed to the oral environment. Caries, erosions, abrasions and abfractions may cause loss of enamel and dentine, resulting in the major cause of dental hypersensitivity. Physical, chemical and mechanical stimuli act on dentinal fluid causing pain and affecting the quality of life of patients. Aim of this study was to evaluate "ex vivo" on human extracted teeth, the possibility to sinterize on dental surfaces a new biomaterial based on fluorapatite, in order to close dentinal tubules.
Methods: A network of 3 Universities (UNIBA, UNILEEDS and UNSTAN) and 4 companies (GTS, M SQUARED,

LASERINN and ICMEA) have collaborated to develop a dedicated laser device for sintering a fluorapatite gel on dental surfaces to obtain a restoration of dentine and /or enamel. The gel is obtained by the synthesis of mineral powder and had the consistency of a toothpaste gel. The gel was applied on the previously prepared dentinal surface and irradiated by a dedicated laser. The lasers used in our study had a wavelength of 980 nm and a variety of pulse durations (from 50 fs to 120 fs) to address the photoactivation of the mineral paste component. To measure the temperature in the dental chamber during the laser sinterization, a thermocouple was positioned in the pulp chamber.
Results: The laser irradiated cross sections of human teeth were analysed using an electron microscope. The section images show the formation of mineral particulates on dental surfaces that completely occluded dentinal tubules. The sintered material had a hardness that was superior to the dentine. Temperature recorded ranged from 22.8 °C to 25.0 °C (not dangerous for dental and oral tissues).
Conclusions: Sintered materials seems to be a promising option in the near future: combined use of new low-cost ultrafast lasers and new bio-gels added to minerals, could substitute the composite resins or desensitizing agents usually employed in dentine hypersensitivity. The time necessary for sinterization remains longer than for conventional photopolymerization techniques. Further studies using newly developed lasers and bio-materials could avoid this limitation. In vivo studies are now needed to evaluate the efficacy and the reliability of the described techniques and materials on a different and challenging clinical scenario.

Spectrophotometric analysis of color stability of various esthetic restorative materials

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Aim: A crucial property of esthetic restorative materials is their long-term color stability: the aim of this in vitro study was to evaluate and compare the color stability of different esthetic restorative materials (Gradia Direct Flo, Filtek Supreme XTE, Ceram·X Universal, Gradia Direct, Admira Fusion) after surface roughening with cola and exposure to different staining solutions (coffee and red wine). The null hypothesis is that esthetic restorative materials do not change color clinically when staining agents are routinely applied.
Methods: Five different materials were polymerized for 40 seconds into silicone rubber rings (2 mm x 6 mm x 8 mm) to obtain 150 specimens identical in size. Half specimens were exposed to Coca Cola for 24 h (group A), the others exposed to physiological solution (group B) and then all samples were immersed in coffee, red wine or physiological solution (control) over a 28-day test period. A colorimetric evaluation according to the CIE L*a*b* system was performed by a blind trained operator at 5 experimental periods: immediately after light-polymerization and at 7, 14, 21, 28 days of the staining process. Color of the specimens was measured with a spectrophotometer against a black background in order to simulate the absence of light in the mouth against a white background. All specimens were chromatically measured 4 times and the average values were calculated; then each color parameter for each specimens of the same shade was averaged. The control samples have not been subjected to the staining process. Shapiro Wilk test and Kruskal Wallis ANOVA were applied to estimate significant differences between the esthetic materials.
Results: The first immersion in soft drink influenced all materials by changing significantly color coordinate CIE L* ($P < 0.05$). Not significant variations were registered for ΔE ($\Delta E < 3.3$). Materials immersed in physiological solution did not show significant changes in each color coordinate ($P < 0.05$) thus providing $\Delta E < 3.3$ even after 28 days. Immersions in coffee and wine caused significant variations for each color coordinate both in group A and group B ($P < 0.05$). Specimens of group A showed higher color coordinate variations when compared with group B's specimens ($P < 0.05$) thus showing ΔE values significantly higher even after 7 days ($P < 0.05$). After 28 days the immersion protocols caused a clinically perceivable color change for all materials tested. Ceram·X Universal and Admira Fusion showed the lowest ΔE variations.
Conclusion: Immersion of specimens in staining beverages caused a significant color change in all types of tested composite resins. The first exposure to Cola influenced the staining susceptibility of all materials, enhancing the subsequent staining with coffee or red wine. Coffee demonstrated a higher staining potential if compared to red wine. Among the different materials tested nanohybrid composites (Ceram·X Universal and Admira Fusion) reported the lowest color variations.

A novel dental implant surface treatment which selectively enhance fibronectin adsorption

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Aim: Dental implants are an essential therapeutic option in everyday clinical practice. Implants osseointegration is deeply influenced by the behavior of cells at the bone-implant interface and depends on their initial attachment, adhesion and spreading, which in turn are affected by surface chemical composition, micro profile and wettability. In particular, all these aspects influence protein adsorption at the interface and thus cell behavior. The aim of this study was to obtain super hydrophilic titanium surfaces and to investigate whether the gain in hydrophilicity alters surface selectivity for fibronectin, a protein which plays a pivotal role in cell adhesion and proliferation.
Methods: Acid-etched sandblasted surfaces were treated through a proprietary process in order to obtain super hydrophilic surfaces. Surface chemical composition was characterized by X-Ray Photoelectron Spectroscopy, while micro topography through Scanning Electron Microscopy (SEM). The gain in hydrophilicity was furthermore assessed by measuring the contact angle between a 5µl water drop and titanium discs. Protein adsorption pattern was analyzed by SDS-PAGE, while the selectivity of surface for fibronectin was investigated through immunoblotting. Subsequently, cell behavior was studied. Murine osteoblasts MC3T3-E1 cells were cultured for 24 hours in complete medium, and their morphology and adhesion studied through the immuno-staining for cytoskeleton and for focal adhesions and through the use of SEM microscopy coupled to Focused Ion Beam (FIB). FIB analysis allowed to cut cells during SEM observation and to study their interactions with the surface. Furthermore, cell adhesion was assessed by quantitating the number of attached cells to the surface at different experimental points through chemiluminescence.
Results: Our results showed that the experimental treatment we developed favors a gain in surface hydrophilicity without alter chemical and morphological properties. Surprisingly, more proteins were adsorbed on treated surfaces after SDS-PAGE analysis, and Western Blot revealed a great enhancement of super hydrophilic surface selectivity fibronectin. Immuno-staining revealed that healthy cells were present on both surfaces, and interestingly cells grown on super hydrophilic surfaces expressed a higher amount of focal adhesions. Similarly, a faster colonization of the discs was observed on the super hydrophilic titanium surfaces. SEM-FIB analysis demonstrated that cells adhered preferentially to the micro texture peaks on standard surface, while super hydrophilicity promoted the complete adhesion of cell body to titanium surface, where cells appeared thinner and well.
Conclusion: Super hydrophilic titanium surface for dental implants induced a modified pattern of protein adsorption characterized by selective adsorption of fibronectin and induced a more uniform osteoblast contact to moderately rough sand-blasted/acid etched titanium.