

INFLUENCE OF POLYMERIZATION TIME ON COLOUR OF 3D PRINTED CROWNS: PILOT STUDY

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Aim: to evaluate the influence of post-printing polymerization time on colour of resin crowns 3D printed with different angles.

Methods: two crowns for teeth number 1.5 and 4.6 were designed. Nine crowns for each model were printed using Zortrax Raydent resin (A2). The two groups were divided into three subgroups of three samples each and different printing angle: 90°, 45° and custom angle; they were polymerized using a 360° blue LED 24W oven, one crown for 30 minutes, one for one hour, and one for 24 hours. A Spectrophotometer was used to analyze the colour and compare it to the control (A2 VITA scale sample).

Results: the colour variation between samples was summarized in a CIE 1976 graphic. The Delta value between the reference sample (A2 VITA scale) and each sample was considered,

defined as the distance between two points in the graphic and expressing the difference in color between samples. This determined which combination of printing angulation and polymerization time was optimal: for crown 1.5 it was printing at a 90° angle and polymerized for 30 minutes, while for crown 4.6 it was printing at custom angle and polymerized for 1 hour.

Conclusions: the post-printing polymerization process is a fundamental phase, which may influence esthetic results of a provisional resin restoration. Crown morphology may influence the effects of polymerization on colour since two different crown designs yielded different results at the same print angulation and polymerization time; a study with greater number of samples to provide adequate statistical analysis is necessary.

A DIGITAL WORKFLOW PROCEDURE TO MAKE A CUSTOM MINISCREW-ASSISTED RAPID PALATAL EXPANSION

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Aim: the aim of this study is to illustrate a digital protocol that can be used for the evaluation and construction of a custom miniscrew-assisted rapid palatal expansion (MSE).

Methods: this type of device can be used in patient with certain requirements. For this reason, it is designed a template of the device to do a non-invasive preliminary clinical evaluation. For the evaluation of the quality and quantity of the bone and the soft tissue a CBCT and a dental scansion of the patient is required. Thanks to the Dolphin 3D software the information from CBTC and dental scan are overlapped and studied. During these studies the maxillary sinus and the dental roots collocation are examined. A particular option of the TINKERCAD program allows to design a 3d model of the appliance with

four miniscrews. After that, the stl. file of the project is generated and imported on Dolphin 3D for planning the virtual placement of the device in the palate. At the end, the negative template of the device on the maxillary 3D model is 3D printed. The 3D printed maxillary model permits the technician to make the appliance based on our digital project.

Results: this digital workflow allows to improve the communication between the orthodontist and the technician. Thanks to these procedures it is possible to create a reliable and accurate custom device based on the patient's characteristics.

Conclusions: the digital method proposed can help the clinicians to plan a predictable placement of the appliance and to create a negative template of the device for its construction.

NICKEL-TITANIUM AND LOW-LEVEL LASER THERAPY FOR TOOTH MOVEMENT RANDOMIZED CLINICAL TRIAL

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Aim: present study evaluated the effects of NiTi coil spring during low-level laser therapy (LLLT) by means of a diode laser in accelerating orthodontic tooth movement (OTM).

Methods: after extraction of first upper premolars for orthodontic purpose, 64 maxillary canines which needed distalization were analyzed in 32 enrolled patients (15 males, 17 females, mean age 12.9±1.8). On all experimental sites, an orthodontic force of 50N was applied by a NiTi closed coil spring obtain space closure. Using a split mouth randomized design, test side was treated using a diode laser operating at 810 nm wavelength in continuous wave mode at both the buccal and palatal side on three points/side (distal, medial and mesial) at baseline and at 3-7 and 14 days and every 15 days until the space closed. On control side, opposite canine was treated only using orthodontic traction.

Results: primary outcome chosen was the overall time needed to complete the levelling and closing space, measured on a study cast. Secondary outcome chosen was the evaluation of pain levels related to tooth traction, using a Visual Analogue Scale (VAS), recorded at 3-7 and 14 days after treatments. Mean space closures of the maxillary canines were comparable between groups.

Laser group yielded less mean time to accomplish space closure compared to the control group. Test side showed a significant reduction in the average range of dental pain at 3, 7 and at 14 days.

Conclusions: this study demonstrates that the use of LLLT therapy was effective in accelerating tooth movement and reducing pain levels related to OTM.

BONDING PERFORMANCE OF A HEMA-FREE UNIVERSAL ADHESIVE TO DENTIN

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Aim: *in vitro* evaluation of the bonding potential, ultrastructural organization and endogenous enzymatic activity of dentin samples conditioned with the novel HEMA-free universal adhesive BeautiBond Xtreme (Shofu).

Methods: forty-eight non-carious sound human molars were cut to expose middle/deep coronal dentin. Groups were formed (n = 8) as follows: 1) Beautibond Xtreme universal in self-etch mode (BXSE); 2) Beautibond Xtreme in etch-and-rinse mode (BXER); 3) iBond Universal (Kulzer) in self-etch mode (IBSE); 4) iBond Universal in etch-and-rinse mode (IBER); 5) Scotchbond Universal (3M) in self-etch mode (SBSE); 6) Scotchbond Universal in etch-and-rinse mode (SBER). After 24h, the specimens were sectioned into 1-mm thick sticks and subjected to microtensile bond strength (μ TBS) test and scanning electron micro-

scope (SEM). To investigate the effect on MMPs activity, 3 additional molars per group were processed for the *in situ* zymography analysis at T_0 . Data were statistically analysed ($p < 0.05$).

Results: adhesive (SBU >IB >BX) and application mode (SE>ER) significantly influenced the μ TBS values ($p < 0.05$). The endogenous enzymatic activity was also influenced by the adhesive and in the ER mode (BX >IB=SBU, $p < 0.05$), while there were no differences between the adhesives in the SE mode ($p > 0.05$).

Conclusions: within the limitations of this *in vitro* study, it may be concluded that ethanol-based SBU showed better bonding performance than acetone-based IB and BX. All the adhesives performed better in the SE mode, possibly due to the lower enzymatic activity compared to the ER mode.

CLINICAL APPLICATION OF THE PACE ALGORITHM IN DENTAL RADIOLOGY

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Aim: PACE (Pipeline for Advanced Contrast Enhancement) is a post-processing algorithm for radiology images that enhances contrast, improving the quality and accuracy of detail, despite a reduction in dosimetry. The efficacy of PACE was already evaluated in chest radiographs of patients with lung parenchyma lesions, where PACE made anatomical details and lesions more evident, sometimes not found in unprocessed images. The aim of this study is to evaluate if the application of PACE in dental radiology can be helpful to the clinician in the detection of anatomical and pathological structures.

Methods: in a first step, unenhanced OPT images were collected and analyzed. Next, PACE was applied to them, obtaining enhanced OPT images that were analyzed. Next, PACE

was applied to them, obtaining enhanced OPT images that were analyzed. Finally, the data collected were compared. The analysis was based on the identification of anatomical and pathological structures present.

Results: the enhanced OPT images showed an improvement in quality, making details more evident. The number of lesions found in both types of images was coincident, but most anatomical structures and pathological lesions appeared with greater definition in the enhanced OPT images.

Conclusions: the application of PACE in OPT images could represent an advantage for the clinician, as it allows to simplify the identification of anatomical structures and pathological lesions, and to reduce OPT imager evaluation times.

STANNOUS FLUORIDE EFFECTS ON ENAMEL SCOPING REVIEW AND AN *IN VITRO* STUDY

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Aim: in recent years there has been a lot of talk about toothpastes with a particular chemical compound: stannous fluoride (SnF₂). Its presence is currently still highly controversial. The different companies that produce toothpastes express its dosage in ppm. The purpose of this systematic literature review is to analyze all randomized clinical trials in the literature over the last 10 years and to draw clear results on the function of stannous fluoride.

Methods: the first analysis of the literature produced a high number of results, subsequently and following a manual analysis of the results, 26 manuscripts have been obtained. A

SEM *in vitro* study has been performed to evaluate the efficacy of CLIADENT toothpaste.

Results: it could be shown that stannous fluoride does not present important contraindications, if not those commonly reported for fluorine. A meta-analysis on enamel loss has been conducted, it shows that SnF₂ products provide better results with a $p < 0.05$ value., the *in vitro* study showed the efficacy of toothpaste on dentin.

Conclusions: this compound could have significant effects in favor of erosion and recalcification of the enamel, on the bio-film formation, gingival inflammation.

SYSTEMATIC REVIEW ON THE EFFICACY OF OZONE THERAPY COMPARED TO OTHER MATERIALS

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Aim: ozone, a triatomic compound, is significantly reactive. There are a lot of advantages about ozone therapy: pain-relieving, anti-inflammatory, antibacterial and tissue revitalizing action.

Methods: known as one of the most powerful oxidizing agents, ozone can react with other organic substances. This property gives ozone a powerful fungicidal and bactericidal activity; The antimicrobial action is given by its ability to damage the cytoplasmic membrane of the bacterial cells. Through its oxidizing properties, ozone acts by stimulating the activation of endogenous antioxidants, which have an anti-inflammatory effect, modulating the immune response of the surrounding tissues. The ozone can be applied to oral tissues in three forms: as a gas, water

and olive oil. It is possible to associate ozone therapy with caries, OLP, gingivitis, osteonecrosis, post-surgical pain, plaque, hypersensitivity, joint disorders and whitening.

Results: scientific evidence demonstrates a better antibacterial effect: it has been reported that the results of ozone therapy can be similar, if not even better than chlorhexidine, in terms of plaque and inflammation. The placement of implant, it can be positively influenced by the use of ozone therapy.

Conclusions: from the heterogeneity of all the studies performed, it can be concluded that ozone therapy covers many dental fields, with satisfactory results.

MECHANICAL AND BIOLOGICAL CHARACTERISATION OF 13 NEW 3D-PRINTED RESINS FOR PROSTHETIC USE

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Aim: to analyse the mechanical and biological properties of 13 additive manufacturing (AM) moulded dental resin materials to understand their prosthetic application in dentistry.

Methods: for each material, 6 specimens were moulded for mechanical analysis and 6 for biological characterisation (to perform repeatability of the tests). From the mechanical point of view, the specimens were studied by means of Dynamic Mechanical Analysis (DMA), to obtain the mean, uncertainty and p value of the Young's Modulus (E^*). Each specimen was subjected to bending tests (Three-Point Bending test) with increasing frequencies (1-100Hz) and stress amplitude of 1N. Biologically, cytotoxicity was analysed using a yellow-purple colorimetric assay (MTT) for mitochondrial succinodehydrogenase (SDH) activity, performed at 3h and 24h.

Results: statistical analysis of E^* shows a rather homogeneous trend for all materials, with the exception of FullCure 720. The materials tested above 21Hz seem to maintain similar E^* and could therefore be used in the mouth, whereas they are more brittle from 1 to 11Hz. Considering uncertainty p value, the most accurate prints turn out to be: FDM, SLA and finally Polyjet.

Although the materials showed a highly significant reduction in viability ($p < 0.01$) at both 3h and 24h, the cells initiated a recovery of mitochondrial activity at 24h.

Conclusions: according to this study, most of the materials examined appear to be effective in clinical application. Future studies will focus on the clinical application of the materials to confirm the results obtained.

RELIABILITY OF MANDIBULAR TRAJECTORIES RECORDED WITH DIGITAL TECHNOLOGY: ITAKA

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Aim: the aim of the study is to evaluate the accuracy of the measurements of a digital movement detection system in gnathologically healthy subjects.

Methods: the preliminary assessment of the reliability of the instrument was performed on students of the Dentistry School of the University of Perugia.

Each subject was submitted to gnathological evaluation using the “Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) Clinical Examination Protocol, version: January 6, 2014”. Subsequently, the non-invasive examination was performed to determine the mandibular movements. The data was processed using a Python code with which the cal-

culatation of the average values and standard deviations of the traces was performed.

Results: with this preliminary feasibility study was possible to create tracings and solid graphs of healthy patients to determine diagnostic criteria which establish, after instrumental examination with Itaka, the regular physiological function of the patient’s gnathological situation.

Conclusions: based on the results obtained in the present study, the Itaka digital movement detection system appears to be reliable in the detection of mandibular tracts and in its diagnostic function. Studies on further variables that can influence the instrumental examination will follow.

FEM AND TSA ANALYSIS APPLIED TO FOUR DIFFERENT MATERIALS SECTIONS OF A CAD/CAM BARS

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Aim: the aim of this study is a FEM (finite element method) comparison, prior TSA (thermoelastic stress analysis) trial, between four posterior section of a CAD/CAM bars with a distal extension element with the same geometry, subject to the same load and constraint conditions, made with different materials: titanium, Co-Cr alloy, Polymethyl methacrylate (PMMA) and zirconium, milled by New Ancorvis srl; Bargellino, Italy and provided by Rhein 83 S.R.L, Bologna, Italy.

Methods: through engineering tools such as TSA, with which the titanium bar was tested, and FEM we could see the distribution of stress on the surface of the bar. Once the model was calibrated, it was used to analyze how the behavior of the sa-

me geometry varies depending on the material used for the realization. Experimental tests were made by an electrodynamic shaker and a thermal imaging camera to subject the part to a load at a known frequency and then to measure its deforming using TSA.

Results and conclusions: we could see that the stress distribution in that section of the bar is very similar between the two machines. The more ductile materials such as Co-Cr alloy and Titanium will have a more elastic response to a deformation caused on their surface, while the zirconium will have brittle behavior, that is reaching brittle failure as soon as it deforms. PMMA has a higher probability of entering a plastic field.

EFFECTS OF SALIVA ON ADDITIVE MANUFACTURING MATERIALS FOR DENTISTRY APPLICATIONS

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Aim: the aim of this study is to evaluate whether the effect of saliva influences the mechanical performance of 4 resin materials printed in additive manufacturing.

Methods: PEEK, Nylon 6 and Nylon 12 were printed by Fused Deposition Modeling (FDM) technique while PP by Selective Laser Sintering (SLS). For each material, six samples were tested, three immersed in a saliva solution for 24h prior to testing and three used as controls. The flexural strength test was carried out using the LLOYO LR 30K instrument with a force capacity of 30kN. The test ended automatically when the specimen began to plasticize. Finally, the average Young's modulus was calculated for each specimen.

Results: all samples confirm that saliva has a negative impact on Young's modulus except for Nylon-6. In this the uncertainty bands overlap although the mean value shows a decrease.

PEEK performs best in terms of elastic behavior with 1794.083 MPa while the worst result is given by Nylon-12.

Conclusions: the corrosive characteristics of saliva have a negative impact on the mechanical performance of these materials. PP shows the highest decrease among the samples as the SLS technology increases the porosity of the surface. PEEK presents a decrease in performance of only 3%, due to its hydrophobicity.