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Fixed Prosthesis

Introduction of a novel Functional Index for Teeth Prosthodontic Score (FIT): A prospective study analyzing single-unit natural abutment crowns after three years of loading

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Objective The aim of this prospective clinical cohort study was to validate natural abutment crowns with a novel Functional Index for Teeth Prosthodontic Score (FIT) an instrument in assessing prosthetic success, as a supportive tool to validate a satisfactory outcome as perceived by patients, to identify possible failure risks, and to compare follow-up observations.
Materials and methods Thirty patients were restored with partial adhesive crowns on natural abutment in posterior sites and annually followed-up for 3 years. FIT was applied for the objective outcome assessment including clinical and radiographic examinations. Seven variables (Interproximal, Occlusion, Design, Mucosa, Bone, Biology and Margins) were defined for evaluation, resulting in a maximum score of 14 per restoration. The patients' level of satisfaction was recorded and correlated with FIT.
Results All crowns revealed survival rates of 100% without any biological or technical complications after three years of clinical service. At the last recall the mean total FIT score was 13.26 and 13.66 respectively for Group 1 and 2, ranging from 12 to 14. All seven variables/parameters (Biology, Bone, Design, Interproximal, Margins, Mucosa, Occlusion) were evaluated and scored as follows with a media ranging from 1.73 to 2. The variable "bone" demonstrated the most consistent results and highest scores with a mean value of 2 (range: 2–2) in both groups. Similarly the mean score recorded for the variable "occlusion" and "mucosa" was 2 (range: 2–2) in Group 1 and 1.9 in Group 2 (range: 1-2). Mean scores for "design" 1.86±0.7 in Group 1 (range: 1–2), and 2 (range: 2–2) in Group 2, "mucosa" 2 (range: 2–2) in Group 1 and 1,93±02 (range 1-2) in Group 2, "interproximal" 1.73±0.7 (Group 1) (range: 1–2) and 2 (Group 2) (range: 2–2), "biology" scored in both Groups 1.93±03 (range 1-2) and "margins" 1.73±08 (range 0-2) in Group 1 and 1.86±07 (range 1-2) in Group 2 and was the most challenging parameter to be satisfied. No statistically significant differences were found between the two groups. The patients expressed a high level of functional satisfaction at or above 80 on the VAS for both questions. The mean score of Q1 was 97 (Q25–Q75: range: 65–100) for group 1 and 98.6±2.5 for Group 2 (Q25–Q75: range: 65–100). The mean score of Q2 was 95.6±1.5 (median: Q25–Q75: range: 90–100) for group 1 and 99±1.5 for Group 2 (Q25–Q75: 73–95; range: 100–100). A statistically significant positive correlation was found between total FIT score and Q1 (Spearman's Correlation Coefficient rho = 0.673; p = 0.006) and Q2 (Spearman's Correlation Coefficient rho = 0.809; p < 0.001).
Conclusions The findings of the clinical trial indicated the potential of FIT as an objective and reliable instrument in assessing implant success. FIT can be considered as a supportive tool to validate a satisfactory outcome as perceived by patients, to identify possible failure risks, and to compare follow-up observation.

Translucent cubic-phase containing zirconia for monolithic restoration: mechanical and optical evaluation, an *in vitro* study\

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Objective The increasing demand for aesthetic monolithic zirconia restorations brought the attention to the performance of recently introduced Translucent cubic-phase containing Zirconia in pre-colored shade. For the present study, measurements of 3-point flexural strength, translucency and color were performed in order to analyze the main optical and mechanical proprieties of Y-TZP restorations with different compositions.
Materials and methods Pre-sintered disks with different shade and composition of Y-TZP (Wieland Dental, Pforzheim, Germany, Zenostar MO4, T1/T2 and MT0/MT2/MT4) were milled in blocks 40 x 20 x 18 mm in a milling machine (Zenotec Select Hybrid, Wieland Dental) and then cut by a slow speed diamond saw (Isomet, Buehler, Lake Bluff, IL, USA) in order to obtain tabs shaped (for optical evaluation with final dimension 15 x 15 x 1.0 mm) and bar shaped (for flexural strength test with final dimension 15 x 4.0 x 1.2 mm). Groups were characterized by the composition and shade (n=15 for flexural strength test and n=10 for optical evaluation) for a total of 150 specimens. The cutting thickness was set in order to compensate the volume sintering shrinkage. Sintering were performed in a furnace (Zenotec Fire P1, Wieland Dental) following the manufacturer instructions and conventional firing time. After sintering all the specimens were wet-finished in a polishing machine with 600, 1000 and 1200 grit papers. Samples were tested in a universal testing machine (Triax 50, Controls, Milano, Italy). Values were measured in N and the flexural strength (σ), Weibull characteristic strength ($\sigma 0$) and the Weibull modulus (m) were calculated. A benchtop spectrophotometer (PSD1000, OceanOptics, FL, USA), equipped with an integrating sphere (ISP-REF, OceanOptics, FL, USA) was used in PC running a color measurement software (OOILab 1.0, Ocean Optics, FL, USA). D65 illuminant and 10° standard observer were selected. Measurements for translucency were carried in CIExyz color system, and the Contrast Ratio was calculated. Color coordinates were recorded in CIELab* color space with a neutral gray background. The ΔE value was calculated for evaluating color differences using the uncolored MT0 as reference point. CR ad σ data were statistically analyzed by the One-Way ANOVA followed by the Tukey test for post-hoc comparison. Pearson's correlation test was performed for factors CR and ΔE. For all the evaluations, the significance was set to p=0.05.
Results Statistically significant differences were found for both factors CR ad σ. Colored Translucent Zirconia resulted in a significant lower flexural strength compared to the not colored MT0. Comparable and higher level of strength were recorded for all the other tested zirconia. A wide range of translucency were measured, materials results in the following order (most translucent) MT0a>T1b>MT2b>T2c>MT4d>MO4e (less translucent). The correlation between translucency and color resulted to be strong (r=0,886).
Conclusion Within the limitations of this *in vitro* study it is possible to affirm that the translucency of the restorations (CR) was directly correlated to the changing in shade (ΔE), and color negatively the translucency. The increase content of Yttria significantly influenced the strength. The pre-colored translucent zirconia MT2 and 4 resulted in a significant lower flexural strength compared to the not colored MT0. All the tested Zirconia fullfill the ISO 6872:2015 Class4 furthermore the MT0 and all the 3Y-TZP tested reach the ISO Class 5 (ISO 6872:2015). These factors should be considered for correctly evaluate the clinical performance of monolithic Y-TZP restorations.

A RCT on posterior teeth restored by disilicate partial crowns with or without posts: A three years clinical service

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Objective The need of post to restore endodontically treated teeth (ETT) is often discussed. The indication to restore ETT with esthetic partial crowns on posterior teeth was recently proposed. The aim of this

prospective clinical trial was to assess the influence of the type of use of posts as well as the type of posterior tooth (premolars vs molars) on 3-year clinical performance of ETT restored with or without fiber posts (ClinicalTrials.gov NCT01532947).
Materials and methods Two groups (n = 60) were defined depending on the type of restored tooth: 1) premolars and 2) molars. Within each group, samples were divided into 2 subgroups (n = 30) according to the placement or not of a fiber post to buildup: A) with post B) without post. The clinical outcome was assessed based on clinical and intraoral radiographic examinations at the recalls after 6, 12, 24, and 36 months. Data were analyzed by Kaplan-Meier log-rank test and Cox regression analysis ($P < 0.05$).
Results The overall 3-year survival rate of ETT restored molars and premolars with posts was 100% whereas teeth in group 2A exhibited the lowest performance (93.3% survival rate). The Cox regression analysis showed that the presence of the post was not a significant factor for survival time (Hazard Ratio HR = 0,388; 95% Confidence Interval for HR = 0,1 to 1,5; p = 0,17). Tooth type had an influence on survival time that was at the limit of statistical significance (Hazard Ratio HR = 0,123; 95% Confidence Interval for HR = 0,015 to 0,997; p = 0,05). Particularly, failure risk was greater for premolars. 'Post by tooth type' interactions were not statistically significant (p = 0,126).
Conclusion: Over a 3-year observation period, the clinical performance of ETT restored with lithium disilicate partial crowns was not significantly affected by the use of a fiber post and by the type of tooth (premolars or molars).

Resin-bonded fixed dental prosthesis made of lithium disilicate: A case series

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Objective To present a case series of resin-bonded fixed dental prosthesis (RBFDPs) made of lithium disilicate (LD).
Materials and methods From June 2015 to June 2018 five patients were treated by means of RBFDPs using lithium disilicate. Four cases regard anterior missing teeth (incisors and canines) and one case regards a premolar. Three bridges were realized with one retainers and 2 bridges with two retainers on adjacent teeth. All the bridges were adhesively cemented using luting composite (Multilink or Variolink Esthetic, Ivoclar Vivadent).
Results The follow-up ranges from 4 to 40 months. One decementation occurred one month after delivery; the bridge was luted again without further complications.
Conclusion Within the limits of this case series, lithium disilicate can be used for RBFDPs in selected cases, with no major complications within 40 months of follow-up.

Marginal accuracy and bond strengths of porcelain to cobalt-chromium alloys fabricated by selective laser melting

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Objective The purpose of this *in vitro* study was to investigate, using a coordinate measuring machine (CMM), the marginal gap (MG) of Cobalt-Chromium alloy copings produced by selective laser melting (SLM) technology before and after ceramic firing. Moreover, ceramic bond strength with the Schwickerath crack initiation test (three-point bending test) according to UNI EN ISO 9693-1 was evaluated.
Materials and methods The study started from a real clinical situation: a patient needed to be rehabilitated with a FDPs of 4 elements. Conventional impression was taken and the master model was scanned by laboratory scanner. The digitized data were transmitted to CAD software program (Exocad) which allowed for the design of the FDP. The STL files were then sent to SLM centre (3D Fast, Padua) for review and fabrication of 80 Co-Cr frameworks. Furthermore, 80 specimens with dimensions of 25 x 3x 0.5 mm were fabricated. The MG between frameworks and abutment tooth of the master model were measured with a coordinate measuring machine (OGP SmartScope Flash, CNC 300). All 80 specimens were measured with digital calliper (Absolute Digimatic Calliper Series 551; Mitutoyo) to confirmed the dimensions according to ISO standard 9693. After the initial measurements, one framework, three specimens, a letter of the project and the practical directions to follow were sent at 80 private dental technicians to ceramic firing for simulating the standard level of the clinical crown manufacture. Two week later, the samples were sent to the Department of Civil, Environmental and

Architectural Engineering of the University of Padua for measurements after ceramic firing. Regarding the MG, the same method of measurement before ceramic firing was performed. To evaluate the ceramic bond strength, the 3-point bending test was applied using a universal testing machine (Galdalbini SUN 2500) with a 25kN load cell at a crosshead speed of 1.5mm/min according to ISO standard 9693. The Wilcoxon matched-pairs signed-rank test (one-tailed) was used to compare groups.

Results Of 80 dental technicians, only 28 provided the samples within the pre-established time. The mean MG of the framework before and after ceramic firing was respectively 25 µm and 34 µm. Significant differences among the MG before and after ceramic firing (p-value = 0.001). The mean result of the 3-point bending test was 33 MPa.

Conclusion All SLM Co-Cr framework showed MG lower than < 120 µm, thus were clinically acceptable. However, not all specimens showed a ceramic bond strength value higher than 25MPa and six dental technicians on twenty-eight were not able to achieve ceramic firing.

A resin-bonded splint made of lithium disilicate: A case report

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Objective Resin-bonded splints are often used to stabilize traumatically displaced or periodontally compromised teeth. Direct splints have several downsides: difficulty in monitoring the detachments, higher risk of decay, difficult oral hygiene, retention for plaque and calculus, and poor aesthetics. Indirect splints are traditionally made of cast metal, that has poor aesthetics, too. Lithium disilicate is an all-ceramic material that combines good mechanical properties and excellent aesthetic results. A strong point claimed for using lithium disilicate is adhesive cementation: indeed, lithium disilicate is a glass-ceramic and it may be etched to increase bond strength. Neither metals nor zirconia present comparable bond strength. Aim of this case report was to present a resin-bonded splint made of lithium disilicate.

Materials and methods The patient G.B. presented at the Dental Clinic, University of Ferrara, complaining about poor stability and poor aesthetics of the existing superior palatal splint. Clinical examination revealed difficulty in oral hygiene, insufficient aesthetics, and history of detachment. An indirect resin-bonded splint was proposed and lithium disilicate was chosen as material. The old splint and composite were removed and a preparation for resin-bonded fixed partial prosthesis was completed on the lingual surface of teeth 1.3, 1.2, 1.1, 2.1, 2.2, 2.3. An impression was taken using polyvinylsiloxane impression material and a cast was realized. An "one-piece" lingual splint was waxed and then pressed by lithium disilicate (Ivoclar Vivadent, IPS e.max Press). The inner surface of ceramic was etched with 5% hydrofluoridric acid (Ivoclar Vivadent, IPS Ceramic) for 20 seconds, then rinsed and cleaned in pure alcohol in ultrasonic bath for ten minutes. Therefore it was treated with universal primer (Ivoclar Vivadent, Monobond Plus) and dried with hot air. Teeth were cleaned and adhesive (Ivoclar Vivadent, Mulitilink Primer) was brushed on. A dual-curing luting composite (Ivoclar Vivadent, Multilink Automix) was applied on the inner surface of the ceramic splint and then the splint was seated on the prepared teeth until the end of polymerization.

Results Two years follow-up showed the stability and the maintenance of the integrity and aesthetics of the splint.

Conclusion Within the limits of this case report, considering dental technician difficulties, the use of lithium disilicate for producing indirect splints may be an option in selected cases.

Implant-supported prosthesis

Brånemark Novum® immediate loading rehabilitation of edentulous mandibles: A 16-year retrospective study

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Objective Numerous studies have demonstrated the high predictability of immediate loading rehabilitations over the medium term. However, there is a lack of long-term studies. Proposed in the early 2000s, the Brånemark Novum (Nobel Biocare AB, Goteborg, Sweden) was the first codified immediate loading protocol to rehabilitate edentulous mandibles. It consisted in the placement of three implants in the interforaminal region with the prosthesis delivery within a day. The aim of this retrospective study was to evaluate the clinical outcomes of edentulous jaws rehabilitated with the Brånemark Novum protocol

over a 16-year period.
Materials and methods Between April 2001 and November 2001, 4 patients were rehabilitated with fixed full-arch prosthesis supported by 3 immediately loaded implants following the Brånemark Novum protocol. Cumulative implant and prosthetic survival rate (CSR), bleeding on probing (BoP), plaque index (PI), probing depth (PD), implant stability (RFA expressed through implant stability quotient ISQ) and peri-implant bone resorption were evaluated over time. Bone resorption, RFA, PI and PD were analyzed using a linear mixed model with random intercept; whilst a negative binomial mixed model was used in the BOP evaluation. A $p<0.05$ was considered statistically significant.
Results During the 16th year of follow-up, no implant failed (CSR of 100%) and the prosthetic CSR was 100%. The statistical analysis did not reveal differences in peri-implant health parameters (PI, BOP and PD) at the various healing times. RFA values remained generally stable during the entire 16-year period. After 11 years, small bone resorption was found next to distal implants (median 1 mm), while central implants showed greater bone resorption. Between the 11th and the 16th year follow-up, bone level remained stable without statistically significant differences between the two time points. One biological complication was detected in a central implant, which exhibited a crater-like bone resorption.
Conclusion The 16-year results highlighted that the Brånemark System Novum protocol is a predictable technique with highly successful outcomes in the long term. This protocol had the merit of indicating the key factors for full-arch immediate loading rehabilitations, namely standardized surgical and prosthesis protocol, rigid metal framework splinting the implants, passive and screwed prosthetic structure, reduced number of implants, and occlusal material with high shock absorption capacity. Nevertheless, the rigidity of the protocol, which could be applied only in patients with specific anatomical characteristics of the lower jaw, caused the dismissal of its clinical application.

Implantology research

Implant-prosthetic rehabilitation using zygomatic implants and a carbon fiber framework

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Objective Several protocols have been proposed to rehabilitate extremely resorbed maxillae avoiding bone-grafting. Zygomatic implants represent a feasible treatment option. Two zygomatic implants can be placed in the posterior areas of the maxilla and traditional implants in the anterior areas or, in case of extreme maxillary atrophy, 4 zygomatic implants can be used (two for each hemiarch). Metal is the most used material to realize passive frameworks in order to prevent micro-movements and evenly distribute occlusal loads onto the implants. However, currently there is a growing interest in composite resins. In particular, carbon fiber reinforced composites (CFRC) provides similar stiffness and rigidity compared to metal and optimal biocompatibility. Compared to metal frameworks, CFRC frameworks present some advantages: they are cheaper, easy to produce, they allow chemical adhesion to the veneering resin and they are lighter. Such characteristics appear to be advantageous for the manufacturing of immediately loaded prostheses supported by zygomatic implants. The aim of this study was to evaluate clinical outcomes of immediately loaded zygomatic implants using a full-arch fixed prosthesis provided with CFRC framework.
Materials and methods Between March 2017 and September 2017, 18 patients (13 women, 5 men) with severely edentulous resorbed maxillae or patients with failed GBR augmentation were identified for this study. Patients presented with a mean age of 62 years (range: 53 – 78) and were treated with fixed screw-retained prostheses supported by zygomatic implants in the posterior areas and traditional implants in the anterior areas (n= 3) or four zygomatic implants, two for each hemiarch (n= 6) or four zygomatic implants and traditional implants in the anterior areas (n= 2). A plaster impression was taken after surgery, and prostheses were delivered within 24/48 hours. The prosthesis presented a carbon fiber framework, veenered with composite resin occlusal material. The carbon-fiber reinforced composite (CFRC) (Bio Carbon Bridge system Micromedica) is composed of unidirectional fibers that have good basic mechanical properties and, moreover can be adapted to the framework shape without the necessity of cutting the fibers to incorporate the implant cylinders, that may increase the mechanical characteristics of the final framework. All the prostheses were provided with balanced occlusion and nightguards were delivered to the patients. Patients were evaluated at the 1-year follow-up and cumulative survival rate (CSR) as well as periodontal parameters were evaluated (BoP, PI, PD). Technical and biological complications were also recorded.
Results 80 implants have been inserted (45 zygomatic and 35 conventional implants). At the 1-year follow-up, no patients dropped out. One implant was removed 4 months after placement due to an infection in a

heavy smoker patient. Despite the removal of the implant, the prosthesis was kept in place maintaining the remaining implants as support. Implant CSR was of 98.8% and prosthetic CSR was 100%. The values of BOP and PD of peri-implant soft tissues never exceeded the physiological levels.
Conclusion On the base of the present study, implant rehabilitation with zygomatic implants and fixed prostheses provided with a carbon framework appears to be a valid treatment option in case of severely atrophic maxillae, with high success rate in the short term period.

Evaluation of prosthetic variables on bone loss around dental short implants: a retrospective study with a mean follow-up of 16 years

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Objective The aim of this study was to evaluate retrospectively the influence of different prosthetic parameters on marginal bone loss around short dental implants placed in the posterior mandible.
Materials and methods All patients treated between 1994 and 2003 in the Dental Clinic of the Department of Neuroscience at the University of Padua (Italy) with short implants (7 mm length) in the posterior mandible were included in the analysis. The prosthetic variables were divided in: clinical CI (cCI) (<2 vs ≥2); implant diameter (3.75 mm vs 4.1 mm); type of prosthetic reconstruction (single crown vs multiple fixed dental prostheses - FDPs); retention mode (cement-retained FDPs vs screw-retained FDPs); antagonist type (natural dentition vs FDPs) and veneering material (ceramic vs resin). A generalized linear mixed model was estimated to identify the predictors of MBL.
Results A total of 109 implants placed in 55 patients were evaluated. The mean follow-up period was 16 years (range 11-20 years). Ten implants in 4 patients were lost resulting in a 91.6% cumulative survival rate. Mean values. At multivariable analysis, CI≥2 was associated with higher MBL (regression coefficient 0.27, 95% CI 0.15 to 0.40), while implant characteristics, follow-up and site were not associated with MBL. The effect of a CI≥2 was estimated in an increase of 0.28 mm in MBL (95% CI 0.14 mm to 0.43 mm). for CI and MBL of implants in situ (n=109) were 2.21 ± 0.24 mm and 1.42 ± 0.38, respectively. The prosthetic success rate was 82.5%.
Conclusion Higher CIR was associated with greater MBL of implant-supported fixed dental prosthesis in short dental implant placed in the posterior mandible, while implant characteristics, follow-up and site were not associated with MBL. However, the increase of 0.28 mm of MBL in patients with a CI≥2 may be not clinically relevant.

Computer assisted technology, Biomechanics, Imaging and Diagnostic Systems

High strength hybrid-ceramic for CAD/CAM milling: a 3-point bending test

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Objective To compare mechanical characteristic (Flexural strength, Weibull modulus, Weibull characteristic strength and Elastic modulus) of different hybrid-ceramic blocks for CAD/CAM milling.
Materials and methods CAD-CAM blocks of Lava Ultimate (3M), Cerasmart (GC), Cerasmart 270 (GC) and Cerasmart 300 (GC) were cut with water cooled slow speed diamond saw in bars shape. A custom support was used to perpendicularly cut the blocks. Specimens were polished and finished with silica carbide papers of increasing grit. Final dimensions of the specimens were 2.0 x 2.0 x 16 mm. Specimens were tested using a universal testing machine for the 3-point bending test. Flexural strength (σ), Weibull modulus (m), Weibull characteristic strength (σ^0) and elastic modulus (E) were calculated. σ and E data were statistically analyzed by two separate one-way ANOVA followed by Tukey test for post-hoc evaluation. The significance was set at $p=0.05$.
Results The main flexural strength resulted in following order: Cerasmart 300^{a} (302±32MPa), Cerasmart 270^{b} (269±22MPa), Cerasmartc (238±20MPa) and Lava Ultimated (191±26MPa). The main Elastic Modulus resulted in the following order: Lava Ultimate^{a} (13.40±0.96GPa), Cerasmart^{a} (11.84±2.14GPa), Cerasmart 270^{ab} (11.60±1.30GPa), Cerasmart^{b} (10,02±2.24GPa). The Weibull modulus resulted to be always higher than 10 for the GC materials and 8.56 for 3M lava Ultimate.
Conclusions The tested hybrid ceramic CAD/CAM blocks showed statistically significant different mechanical behaviors. Flexural Strength and Elastic modulus result in an inverse relation. The material selection should take into account that hybrid ceramics demonstrate different characteristic, and these could be a pivotal factor in the prognosis of

CAD/CAM single restorations.

Accuracy of intraoral scanners in dental vertical preparation: An *in vitro* study

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Objective The aim of this study is to evaluate the sulcus impression accuracy of five different intraoral scanner devices of tooth with vertical preparation.
Materials and methods A resin first molar of a training model was prepared with a finish line simulating a complete crown coverage. The model was then taken by an intraoral scanner. The digital impression was manipulated in a CAD software to create two virtual models with different sulcular depth around the prepared tooth. In model A the artificial gingival sulcus had 0.3 mm apical width, 0.6 mm coronal width and a depth of 1 mm. The sulcus in model B was the same of the model A but its depth was 2mm. Starting from models A and B, two stereolithographic models (H1 and H2) were fabricated through digital light processing (DLP) and their sulcular dimensions were verified by a profilometric analysis. Five different intraoral scanners (3Shape-Trios, 3M-TDS, DensplySirona-Omnicam, Planmeca-Emerald, Condor Intra Oral Scanner) were used to take 10 digital impression of H1 and H2 models with a total of 100 digital impressions. Each digital impression was exported and analyzed through a specific dental software (3Shape-3D Viewer) to evaluate the apical width (AW), the coronal width (CW) and the depth (D) of the impressed sulcus. The artificial gingival sulcus around the teeth was analysed in 120 different points with a total of 6000 measurements.
Results Trios recorded: in H1 model AW 0.300±0.027 mm, CW 0.600±0.033 mm, D 1.000±0.033 mm and in H2 model AW 0.300±0.048 mm, CW 0.600±0.03 mm, D 1.953±0.032 mm. TDS recorded in H1 model AW 0.257±0.028 mm, CW 0.600 mm±0.032 mm, D 1.000±0.072 mm and in H2 model 0.254±0.038 mm, CW 0.600±0.034 mm, D 1.981±0.078 mm. Omnicam recorded in model H1 AW -0.281±0.065 mm, CW -0.600±0.065 mm, D -0.943±0.108 mm and in model H2 AW -0.276±0.045 mm, CW -0.600±0.104 mm, D -1.888±0.164 mm. Emerald recorded in model H1 AW -0.214±0.082 mm, CW -0.600±0.08mm, D -0.862±0.169 mm and in model H2 AW -0.199±0.14 mm, CW –0.600±0.077 mm, D –1.719±0.3 mm. Condor Intra Oral Scanner recorded in model H1 AW -0.262±0.062 mm, CW -0.600±0.082 mm, D -0.643±0.18 mm and in model H2 AW –0.274±0.065 mm, CW –0.600±0.108 mm, D -0.456±0.159 mm.
Conclusions The intraoral devices used in this study showed different levels of accuracy, this could be explained by the different technologies. The procedure used in this *in vitro* study showed to be a reliable and repeatable method to evaluate the sulcus impression accuracy captured by different intraoral digital scanners.

Influence of Implant Scan Body (ISB) material and surface over the accuracy of intraoral optical surface scanning (IOS) for implant impression: A randomized *in vitro* trial

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Objective The aim of this *in vitro* study was to evaluate the influence of ISB material and surface onto the accuracy of IOS for complete arch multiple implant impression.
Materials and methods An edentulous maxillary master model set-up with 6 internal connection dental implant analogues was scanned with an extraoral optical scanner to achieve a standard tessellation language (STL) file to be used as a reference for the study measurements. Three ISBs with the same geometry but different materials, polyetheretherketone (P), titanium (T) and PEEK with a titanium base (PT), were scanned according to a randomized sequence with an IOS device. The 45 test STL files were obtained by three different experienced operators and then aligned to the reference scan with a 0,01 mm tolerance best fit algorithm. Linear (X, Y and Z-axis) and angular deviations (DeltaANGLE) were measured for each analogue (n=270). Absolute values of the linear discrepancies were summed up to obtain a tridimensional discrepancy value (DeltaASS). ISB material influence over DeltaASS and DeltaANGLE was statistically analyzed through a hypotheses test for mixed model analysis of variance with Tukey adjustment for multiple comparison.
Results DeltaASS LS Means resulted as 0.0547 mm for P, 0.0992 mm for T and 0.1964 mm for PT. Considering DeltaASS, P was significantly more accurate than T (p=0,0096) and PT (p<0,0001). T was significantly more accurate than PT (p<0,0001). DeltaANGLE LS means were P 0,6423°, T 0,7137°, PT 0,7600°. Considering DeltaANGLE, P was significantly more accurate than PT (p=0,0178). While no statistically significant difference was found between P and T (p=0,2216) as well as between T and PT (p=0,5273).
Conclusions Within the limitations of this study, ISB

material seemed to influence the accuracy of digital complete arch implant impressions obtained through a confocal microscopy IOS. P expressed the best results on both linear and angular measurements, followed by T. PT resulted as the less accurate.

Resistance to load and marginal quality of composite CAD/CAM endocrowns with and without margin relocation

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Objective To evaluate the influence of the margin relocation on the resistance to load and marginal quality of molar teeth restored with composite endocrowns obtained via computer-aided-design/computer-aided-manufacturing (CAD/CAM) processes.
Materials and methods Sixteen maxillary third molars were axially sectioned with a cylindrical diamond bur 2 mm coronal to the cementoenamel junction. After endodontic access cavity preparation, the canal system of each tooth was mechanically instrumented with Mtwo nickel-titanium rotary files and filled with the continuous wave of condensation technique. At this point, the teeth were randomly assigned to two experimental groups (n=8): in the control group, the canal orifices were sealed and the cavity undercuts filled with flowable composite (AP+ Flow) after self-etch adhesive procedures; in the margin relocation group, a 4 mm-wide proximal box was prepared 2 mm apical to the cementoenamel junction and the same flowable composite was used for margin relocation. Making use of the Cerec 3 CAD/CAM system, the prepared teeth were scanned and composite endocrown restorations produced (Lava Ultimate). After luting the milled endocrowns with self-adhesive cement, the specimens were thermomechanically aged with a chewing simulator (1,200,000 cycles, 1 Hz). Positive resin replicas of the restored teeth obtained before and after aging were observed at the scanning electron microscope to score the margin quality. The restored teeth were occlusally loaded to fracture with a universal testing machine, recording the type of fracture. The two tested groups were compared in terms of resistance to load with an independent-sample t-test and in terms of margin quality and fracture pattern with a chi-squared test; a McNemar test served for the comparison of margin quality before and after aging within the same group ($p<0.05$).
Results The maximum load to fracture was 1802.13±440.45 N in the control and 1598.45±442.75 N in the margin relocation group. The prevalent fracture type was the fracture below the cementoenamel junction. In the margin quality assessment, gap and irregularities at the adhesive interfaces were absent in almost the totality of the observed surfaces and unaltered by the simulated aging. No statistically significant differences between the groups with regard to the variables of interest emerged.
Conclusion The resistance to fracture offered by the tested composite endocrown restorations exceeded, on average, 2 to 3 times the limit of the masticatory forces. The margin relocation with flowable composite did not seem to affect the resistance to fracture, the fracture type, or the margin quality of the restored tooth. This latter variable was not influenced by the thermomechanical simulation of 5 years of clinical service.

Dental Materials

Adhesion of 4 different impression marerials to Flock-PA66 covered dental tray

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Objective An innovative standard impression tray has been recently released. These new trays are fully covered with a tiny colored layer of microfibers (Polyamide Nylon), self-retentive for all impression materials without applying any adhesive. Aim of this investigation were:
- to assess the tensile bond strength of different impression materials (2 polivinylsiloxane and 1 Polyether) used in combination with a Polyamide nylon flock tray (Flock PA66), a standard plastic tray (PC-110) and a stainless steel standard tray,
- to compare results between flocked dental tray and a metal tray, with or without holes, using an alginate.

Materials and methods 90 squared boxes were manufactured for the study as well as 90 specimens/trays (30 Flock PA66, 30 PC-110 and 30 stainless steel). Specimens were treated with adhesive according to indications given by the manufacturers. The Impression materials selected were Aquasil Ultra Heavy (Dentsply), Impregum and Imprint 4 Penta Heavy (3M). Boxes were filled in with impression material and the specimens were embedded into the impression material and maintained in position following the manufacturer instruction for material

polymerization. Then, materials were fully set, each was pulled in tension with a crosshead speed of 250 mm/min until failure occurred. Normality and ANOVA test were conducted. Since differences were significant, a Tukey Post hoc test was run to evaluate pairs of group that differs. In order to reach the second aim of the study 30 squared boxes were manufactured as well as other specimens (10 Flock PA66, 10 stainless steel with escape holes and 10 Stainless Steel without holes). Stainless steel tray have been treated with adhesive, while none adhesive have been applied on flocked specimens.

Results The Tukey post hoc test identifies three subsets. The Flock PA66 specimens showed higher adhesion values than the Plastic PC-110 and Stainless Steel covered with adhesive for each tested impression material. Impregum and Aquasil Ultra Heavy combined with Flock PA66 showed the best value of adhesion, relevant at 5% level of significance. When used with alginate, flocked and steel tray with hole have the same behavior. Stainless steel tray without holes showed weak adhesion.

Conclusions Tensille bond strength reach greater value using flocked surface, than non flocked surfaces covered with adhesive. The use of Flock PA66 as a tray coating system seems to be a better alternative to the use of conventional metal or resin tray covered with adhesive. Best value of adhesion occur when Polyether and flocked surface is used. The alginate tests showed that flocked surface and steel with escape hole could reach good adhesion value able to resit to strength exercised during removal of the impression from the oral cavity. Using a flocked surface is possible to reduce time spent for impression, reaching satisfactory adhesion values with all the tested materials. The use of a single-use impression tray can also reduces the need to sterilize the tray and the risk of cross-infection.