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Implant Supported Prosthesis

Influence of prosthetic variables on marginal bone loss around short implants with 11 to 20 years of follow-up

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Objective: There is the need for more clinicians to understand the influence of the crown-to-implant (CI) ratio on marginal bone loss (MBL) to evaluate retrospectively the influence of the CI ratio and of different prosthetic parameters on MBL around short dental implants placed in the posterior mandible.
Materials: 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 (3.75mm vs 4.1mm); prosthetic type of 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). The Wilcoxon test was used for group comparisons. Univariate linear regression model analysis with stepwise-forward selection was used to determine the combined effect of the implant diameter, prosthetic type, retention mode, antagonist type, veneering material and clinical CI on MBL.
Results: A total of 119 implants placed in 55 patients were evaluated. The mean follow-up period was 16 years (range 11 to 20 years). Ten implants in 4 patients were lost resulting in a 91.6% cumulative survival rate. Mean values for CI and MBL of implants in situ (n=109) were 2.21 ± 0.24mm and 1.42 ± 0.38, respectively, without significant association. Statistically significant differences for MBL were found between different implant diameters (p = 0.03), veneering materials (p = 0.03), and retention modes (p = 0.02). The prosthetic success rate was 82.5%.
Conclusion: While no significant relation between CI ratio and MBL was found, veneering materials, implant diameters and retention modes had a significant influence on the bone loss.

Computer Assisted Technology, Biomechanics, Imaging and Diagnostic Systems

Evaluation of the accuracy of digital impression for full-arch implant-supported fixed dental prosthesis with six different intra-oral scanner

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Objective: The aim of the present study was to evaluate the accuracy of digital impression for full-arch implant-supported fixed dental prosthesis with six different intra-oral scanners.
Materials: A virtual model of a mandibular edentulous with six scan-abutment positioned vertically at different height was designed by software (CAD) and subsequently manufactured in zirconia by a CNC machine tool (master model). The master model was measured with a coordinate measuring machine (CMM) (SmartScope Flash). The coordinates of the probed points were transferred into a 3D CAD software

(Rhinoceros 5.0 Beta) and analyzed with a task specific evaluation protocol to estimate the position and orientation of each scan-abutment. The master model was directly digitized using six different intraoral scanner (n=15 for group). The software called "Scan-abut" was realized as a plug-in for Rhinoceros 5.0. Three-dimensional distances between reference points of digital impression and reference points of master model along the x-, y-, and z- axes were calculated at each position for all impression. 3D Position and 3D Distance analysis were calculated to compare the six intra-oral scanners. The Wilcoxon matched-pairs signed-rank test (one-tailed) was used to compare groups. The level of statistical significance was set as α = 0.05 and with a statistical power of 80%.
Results: 3D Position analysis showed a mean deviation value respect the master model (trueness) of 31 µm (SD 9 µm) for Scan A, 31 µm (SD 5 µm) for Scan B, 60 µm(SD 31 µm) for Scan C, 246 µm(SD 81 µm) for Scan D and 98 µm(SD 23 µm) mm for Scan E and 60 µm(SD 18 µm) for Scan F. 3D Distance analysis showed a good linear relation between error and distance with Scan A and Scan F. There was no statistically significant difference between Scan A and Scan B (p-value = 0.47), but a significant difference was present between all the groups.
Conclusion: Based on the results of this in vitro study, the Scan A demonstrated the highest accuracy. Four intraoral scanner device did not achieve the necessary level of accuracy to be used for full-arch implant-supported fixed dental prosthesis.

Dental Materials

In vitro evaluation of resistance to fracture and debonding of metal-free cantilever resin bonded fixed partial dentures (RBFDPs)

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Objective: Metal-free resin-bonded fixed partial dentures represent a highly aesthetic and conservative treatment option, especially for young patients waiting for implant therapy in the aesthetic area (congenitally missing lateral incisors typically) The aim of this study was to evaluate the resistance to fracture and debonding of metal-free cantilever resin bonded fixed partial dentures (RBFDPs).
Materials: The following study examined 60 specimens of different materials and bonded with two different cements , divided into 6 groups (ZP: Zirconia with Panavia V5, ZR. Zirconia with RelyX Ultimate, DP: Lithium Disilicate with Panavia V5,DR: Lythium Disilicate with RelyX Ultimate, HP: HIPC with Panavia V5, HR: HIPC with RelyX Ultimate), luted to bovine teeth. The specimens were tested under static load on a universal testing machine (MTS Acumen 3, Eden Prairie, MN USA), until the prostheses either debonded or failed under its load.
Results: The mean fracture load for ZP was 178 N, 230 N for ZR, 138 for DP, 189 N DR, 173 for HP and 133N for HR. There was statistically significant differences between Zirconia with RelyX and HIPC with RelyX Ultimate) (p-value = 0.003). There were no statistically significant differences for the other groups.
Conclusion: The 6 groups showed a clinically acceptable resistance to fracture and debonding. The use of Lithium Disilicate RBFPD is preferable for a definitive restoration for its high aesthetics and strong adhesion performances, in particular with the use of RelyX Ultimate. The Zirconia finds indication in bruxist patients due to its better resistance to stress and overload.

Dental Technology and Technical Procedures

Evaluation of three different scanning techniques in full-arch implants digital impression using intraoral scanners: a randomized controlled cross-over trial

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Objective: Digital impression are becoming a common clinical practice, however little information is available on the different techniques of scanning. The purpose was to compare three different techniques of scanning in a full-arch digital impression and to evaluate the time of scanning and learning curve of digital impression by inexperienced operators.
Materials: A zirconia model of an edentulous mandible with six scan-abutment was used as a master model and its dimensions measured with a coordinate measuring machine. Three different techniques of scanning (MetA; MetB and MetC) were applied on the master model with an intraoral scanner (Zfx GmbH). Nine students were divided in three groups. All students were instructed how to use the technique assigned. Each group knew only the scanning

technique assigned. Each student performed 3 scans. All the digital impression were imported and analyzed with industrial reverse engineer software (Rhinoceros 5.0 Beta). 3D Position and 3D Distance analysis were calculated to compare the three scanning techniques. The acquisition times (minutes) of each scan were recorded. One-way analysis of variance with a post hoc analysis (Bonferroni's test) was used to compare the three groups.
Results: The 3D position analysis showed that the accuracy of the three different scanning techniques have not statistically significant differences (p value = 0.386). The 3d distance analysis showed that MetB had less distance errors dispersion.
Conclusion: Scanning technique MetB is more appropriate with respect to MetA and MetB with this intra-oral scanner.

Implantology Research

Outcomes of cemented versus screw retained customized CAD/CAM zirconium abutments for single tooth implant rehabilitation in esthetic areas: a 10 years randomized prospective study

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Objective: Standard titanium abutments can be considered the 'gold-standard' in single-implant rehabilitations, even if under thin vestibular mucosa they can cause gingival discoloration. A relative recent trend involves the use of customized components enabling ceramic material to best support the mucosa in order to optimize the emergence profile of the prosthetic restoration. Zirconia abutments may help in esthetic situations thanks to their white (or tinted) color and its mechanical properties. The aim of this study was to evaluate clinical performance of customized zirconia single-implant abutments comparing screw retained to cemented rehabilitation. The hypothesis was that cemented and screw retained rehabilitations are comparable in terms of prosthetic, biological and aesthetic outcomes.
Materials: Forty-seven patients were provided with 47 implants (Regular Neck, Tissue level implants, Straumann AG) supporting single-tooth restorations with customized zirconia abutments in anterior areas. Participants signed an informed consent and were randomly assigned to the screw retained (Full Crown abutment, FCA) and to the cemented group (Zirconia Crown, ZrC) and were followed up for 10-years. Prosthetic and biological complications were assessed for the two groups. Marginal bone level (MBL), mucosal recession, pink esthetic score (PES) and white esthetic score (WES) were calculated for both groups.
Results: This study indicates a successful use of customized zirconia single-implant abutments during the 10 years follow up period. All the implants remained osseointegrated with a minimal marginal bone remodeling and 15% complications were reported in association with the restorations. Esthetically, both prosthetic techniques obtained good results in terms of soft tissue adaptation and mimicry with neighboring teeth. The cemented solution seems not to affect any negative marginal bone remodelling thanks to the customized finish line.
Conclusion: The two groups were not statistically different. Nevertheless, even if this prosthetic solution presents future potential, additional studies with bigger samples are needed to report results concerning long-term resistance and stability on larger population samples.

Evaluation of internal and external hexagon connections in immediately loaded implants in fixed full-arch rehabilitations: split-mouth study

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Objective: The objective of this research is to evaluate if a different morphology of the abutment-implant connection (internal vs. external hexagon) is able to condition the behavior of hard and soft periimplant tissues and the incidence of prosthetic complications.
Materials: Between September 2015 and July 2017 a sample of 9 patients (6 males, 3 females) was selected for this study at the time of the follow-up appointment for professional oral hygiene. The mean age of patients was 57,6 years (range: 47 to 72 years) at the time of the follow-up appointment. All patients were rehabilitated with fixed full-arch rehabilitations supported by 4 to 6 immediately loaded implants (length 10 mm) following the Columbus Bridge Protocol (Tealdo et al., 2014) at the Division of Implant and Prosthetic Dentistry of Genoa University (Head Prof. Paolo Pera, Dep. Surgical Sciences, DISC). In each patient 4-6 implants with identical macro- and micro-topography were inserted: 2 external hexagon implants in one side of the dental arch (randomly selected), and 2 internal hexagon implants in the other side. Fixed screw-retained dentures were delivered within 48 hours. At 3, 6 and 12 months of healing and then annually the fixed prostheses were unscrewed and the following parametres were recorded: bleeding on probing (BOP) in four points for each implant using a non-metallic probe (values from 0 to 4) and plaque index (PI) using an erythrosine gel. Peri-implant bone level was evaluated radiographically. The implant-

abutment interface was used as the reference point and interproximal bone level was measured from this reference to the most coronal bone at the mesial and distal side of each implant. Data were analysed using a non-parametric test (Spearman's rank correlation).
Results: At 12 months of follow-up one external hexagon implant failed, resulting in an implant CSR of 97.67%. The prosthetic CSR was 100%. Mean periimplant bone resorption at 12 months of healing was 1.4 mm (SD 0.55). The statistical analysis did not reveal differences in bone resorption between external hexagon implants (mean 1.5 mm, SD: 0.45) and internal hexagon connections (mean 1.25 mm, SD 0.55) nor for periimplant health parametres (IP, BOP and PD) at the various healing times. At 12 months of follow-up, the mean values of IP, BOP and PD were 59.6%, 15.3% and 2.1 mm respectively for external hexagon implants and 68.8%, 27.1% and 2, 1 mm respectively for internal hexagon implants.
Conclusion: In the present study, no statistically significant differences were observed between external and internal hexagon implant connections. The two types of implants have been clinically reliable, as only one implant has been lost. PI values recorded at 12 months of healing were high: they reached an average value of 59.6% for external hexagon implant connections and 68.8% internal hexagon implant connections. However, periimplant bone resorption recorded at 12 months of healing was limited (mean 1.5 mm). Also soft tissue health parametres (BOP and PD) were satisfactory for both implant types.

3D analysis of the accuracy of the implant position in static guided surgery

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Objective: The advent of new technologies in dentistry has revolutionized workflow. Among the branches of dentistry, implantology has undergone major changes due to the possibility of planning implant position before surgical procedure. The correct positioning of the implant has obvious advantages: predictable aesthetic result, long-term stability of hard and soft peri-implant tissues, possibility of proper oral hygiene and the possibility of ensuring optimal occlusion and correct implant loading. The aim of the study is to evaluate the accuracy of static guided surgery. The data were evaluated on the basis of the type of support of the surgical template and on the possibility of having total or partial guided surgery performance.
Materials: 64 implants were inserted using Straumann's Static Surgery protocol. 18 implants were inserted with full guided technique, with dental support template, 22 implants with partially guided technique with dental support template and 24 implants with mucous support template. Subsequently a digital impression with scanbody was taken. Codiagnostix software overlapped the STL file of the intra-oral scan to the initial Dicom file, so as to evaluate the difference in the implant position compared to programming at the implant head, implant apex and implant axis. Statistical tests, Kruskal-Wallis and One-Way analysis of variance were used to evaluate the differences among the 3 surgical methods.
Results: The average angular deviation of the systems with Full Guided technique dental support is 3.16°+/-1.67°; with Partially Guided technique with dental support is 3.33°+/-1.81°; and finally the mucous support is 4.19°+/-2.62°. As far as the implant head off-set is concerned, we have respectively: 0.74mm+/-0.42mm for Full guided technique; 0.99mm+/-0.51mm for Partially guided technique; 1.16mm+/-0.45mm for mucous support template. The average values of implant apex off-set for Full-guided technique are 0.97mm+/-0.59mm.; for Partially guided technique 1,19mm+/-0,50mm; for mucous support technique 1.42mm+/-0.46mm.
Conclusion: Full guided dental support template have been found to be more accurate than mucous support template. If protocols are followed and Full Guided dental support is used, the precision values of the surgery reach a mean 0.74mm at the implant head level and 0.97mm at the implant apex level. In our study, the maximum errors reached are 2.35 mm for the implant's head and 2.61 mm at the implant apex, considering the three different surgical methods. The statistical analysis has found that there is no correlation between the type of surgical intervention and the angular deviation, so there is no more accurate static guided surgery in relation to angular deviation.

Removable Prosthesis, Full and Partial Dentures

Neutral zone vs conventional mandibular complete dentures: Effects on patient satisfaction and oral-health related quality of life

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Objective: To evaluate the effects neutral zone manufactured dentures on patients general satisfaction and on oral health-related quality of life (OHRQoL) of edentulous patients compared to conventional denture (CV).
Materials: In this prospective clinical trial, 31 eden- tulous

patients in both arches were selected to be treated with new set of dentures. Patients were evaluated regarding bone resorption and randomized divided on two groups: Group 1 (N=15) and Group 2 (N=16) respectively treated with CV and NZ mandibular dentures. Cumulative scores from the 14-item oral health impact profile (OHIP-14) for both groups dentures were recorded at pre and post treatment time, data were analyzed using Chi-square test (p-values < 0.05). Following deliv- ery, several denture-related satisfaction variables were measured using 100 mm visual analogue scales.
Results: Patients reported not significant difference at pre treatment time in between groups regarding satisfaction and Ohip-20 values (CV: 12.13 NZ 12.45 p>0.05). However after treatment NZ group reported significant changes in mean OHIP-14 scores (6.78 p < 0.05) and vis- ual scale patient evaluation. The most prevalently affected domain was "functional limitation", fol- lowed by "psychological discomfort" and "Phonetic Capability". There were no significant differ- ences dependent on age, gender (p>0.05). Patients with hight bone resorption reported better im- provement in Ohip-14 mean scores in NZ group comparing to CV group (p<0.05).
Conclusion: Preoperative and post-treatment assessments of patient satisfaction exhibited significant differences. The NZ manufactured dentures had a positive effect on the OHRQoL, which improved bet- ter in patients with high resorption.

Fixed Prosthesis

Rehabilitation of a mandibular lateral incisor by means of lithium disilicate cantilever resin-bonded bridge

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Objective: To present a clinical case of a rehabilitation of a mandibular lateral incisor by means of a lithium disilicate cantilever resin-bonded bridge
Materials: The patient, R.T., 76-old-age presented at Dental School, Dental Clinic of the University of Ferrara because of a coronal-radicular horizontal fracture of left mandibular lateral incisor, element 3.2. (fig. n°1). The tooth has been judged not recoverable so, according to the patient, it was chosen to extract and replace with a fixed rehabilitation by means of a resin-bonded bridge. An alginate impression was taken to realize a removable partial denture (RPD) as a temporary solution. Then, the root was extracted and the RPD was adapted. After soft tissue healing (fig. n°2) the preparation for the retentive element on the adjacent canine (element 3.3) was made: the choice was a minimal chamfer in enamel thickness alongside the edge of the lingual surface and a support at the cingulum (fig. n°3). A polivinylsiloxane impression was taken and the wax up of the bridge was created by dental technician and then pressed into lithium disilicate (IPS e. Max Press, Ivoclar Vivadent). Clinical check showed an optimal integration (fig. n°4-5). The cementation was performed under rubber dam (fig. n°6) using an adhesive cementation system. The internal surface of the retainer was etched with fluoridric acid for 20 seconds and then rinsed in ultrasonic bath in pure alcohol for 5 minutes. A silane was then applied for 60 seconds and then hot dried for 60 seconds. The adhesive was applied on element 3.3 and dried. A dual-curing luting composite (Multilink Automix, Ivoclar Vivadent) was used (fig. n°7).
Results: Current clinical trend sees the use of implant as first, and often unique, rehabilitation solution to replace missing teeth. Sometimes however traditional prosthetic solutions offer better esthetic and functional result. In this case the little quantity e quality of the bone would have required regenerative techniques for making implant therapy possible, without the guarantee of an optimal esthetic result. Moreover, the patient preferred to avoid surgical operations. After the exclusion of the implant option, the choice for a fixed rehabilitation was between a traditional fixed bridge and an adhesive prosthesis. Resin-bonded prosthesis recently showed good long-term success and survival rate (Zalkind 2003), also when all-ceramic materials are used (Kern 2005; Rosentritt 2008). In the present case lithium disilicate was chosen because of its adhesive luting capacity, that represent the key for success in this kind of rehabilitation. A single retainer was chosen because of it showed better prognosis (Sun 2013; Tsitrou 2012).
Conclusion: The Authors argue that adhesive prosthesis may be a valid therapeutic option for the rehabilitation of anterior teeth and that lithium disilicate is the ideal material thank to its excellent aesthetic performance and the possibility of adhesive cementation.

Evaluation of the marginal fit of zirconia crowns with different finishing lines: an experimental study

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Objective: The discrepancy between the margin of preparation and the prosthesis limit is an important measurement value for evaluating the "fit" of the prosthesis. The "marginal gap" can be described as the linear distance between the preparation line and the restoration margin. McLean and von Fraunhofer concluded that 120 µm was the maximum value

clinically acceptable (McLean, J., & von Fraunhofer, J. (1971). The estimation of cement film thickness by an in vivo technique. Br Dent J, 131, 107-11.)
The aim of this work was to evaluate the marginal fit of monolithic zirconia crowns on individual dental abutments prepared with 3 different finish lines.
Materials: For this in vitro test, 18 natural dental elements were selected.
The 18 dental elements were divided into 3 groups depending on the finishing lines:
- 6 teeth prepared with a chamfer
- 6 teeth prepared with a 90° shoulder
- 6 teeth prepared with a feather edge

The abutments were scanned with the intraoral scanner CEREC OMNICAM. The crowns were digitally designed and then milled from zirconia blocks by CEREC MC XL milling unit.
Four points (one on each side of the tooth) were chosen for measurement. Measurement was achieved by means of a camera optical microscope LEICA model WILD M10. and specific software Leica Acquire.
Results: An essential prerequisite for understanding the accuracy of a CAD-CAM prosthesis is the analysis of the digital file. In this passage the anatomy is not reproduced so faithfully. The present results show the difficulty of reading the finishing line on the virtual abutments, especially in the feather edge preparation. It seems that the more the finishing line is defined, the smaller the "marginal gap" and the better the "fit" of the prosthesis.
The emerged results were (values are in micron):
- for chamfer shoulder; Average 130, Highest value 400, Lowest value 30;
- for 90° shoulder; Average 60, Highest value 170, Lowest value 10;
- for feather edge; Average 230, Highest value 830, Lowest value 20.

An analysis of variance (ANOVA) was performed to compare means. Feather edge values were significantly greater than those of the 90° shoulder (p=.001), while there were no differences between chamfer and 90° shoulder, and between the chamfer and feather edge.
Conclusion: Within the limits of this study, results suggest that the type of finish line affects marginal discrepancy in CAD - CAM prosthesis.

Mini-invasive preparations based on mathematical-geometric criteria derived from the anatomic-functional geometry (AFG) modeling technique: a finite element analysis (FEA)

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Objective: The aim of this study was to evaluate the mechanical behavior of a simplified and standardized anatomical preparation inspired by the concept of the AFG modeling technique.
A comparison between the AFG preparation and a standard one by means of a nonlinear finite-element analysis was accomplished in order to evaluate possible differences in the ideal occlusal load transfer.
Materials: Twelve extracted posterior teeth (extracted for periodontal or orthodontic reasons) were duplicated two times by using a stainless-steal master die filled with polymethyl-metacrylate resin and prepared at a constant thickness of about 1 mm with both AFG technique and standard technique, by the same operator, in order to receive a metal free ceramic crown. According to the AFG modeling technique there are four anatomic levels: the first one express the curved lines. The second one is composed by triangles on the sides of the primary crests. The third level includes the primary crests, identified geometrically with lines. The fourth level is determined by the apex of the cusps identified with a point. These geometric references are used by AFG backwards in modeling. In our work we have used them to make a schematic and predictable prosthetic preparation that respects the dental anatomy. The first step involves the abatement of the surface anatomy (curves) and the exposure of the triangular base forming the geometric background of the tooth. Afterwards, the cuspids (points) and the repetitive orientation of the primary ridges in normal anatomy (lines) are identified. Then, guide grooves are carried out at the level of the occlusal grooves and over the primary crests, previously identified. The reduction of the tooth axial walls follows. To perform the control standard preparation the minimal preparation suggested for ceramic crowns was chosen, a wall taper of 6 degrees was applied to the preparation until the CEJ that was completed with a 1 mm chamfer finish line. The three-dimensional (3D) geometry of each sample was generated by combining computer-aided-design (CAD) techniques and optical scanner technology, and it was composed of three subregions: prepared tooth, ceramic crown and cement region. The cement region separated tooth and crown. Each region was assumed homogeneous and to behave as an isotropic linearly-elastic material, mechanical properties set in agreement

with specialized literature. All interfaces were assumed perfectly bonded. Numerical simulations were carried out by considering the tooth model undergoing physiological loads, and accounting for the periodontal ligament (PDL). Following the modeling strategy in, PDL nonlinearities and anisotropy were described via a discretized distribution of non-linearly elastic spring elements, acting along the normal direction to the constrained tooth surface and whose tangent stiffness locally depended on the local strain level. In particular, the PDL nonlinear modeling was based on the multi scale formulation proposed in. Nonlinear numerical simulations were performed via an incremental approach, based on an updated Lagrangian formulation and implemented in a home-made Matlab code, exploiting FEA capabilities of COMSOL Multiphysics.
Results: In order to carry out a comparative analysis of different dental preparations, the mechanical interaction between ceramic crown and prepared tooth was mainly assessed by evaluating the stress distribution at the crown-tooth interface (namely, into the cement region). The spatial distribution of Von Mises stress, measured at the crown-tooth interface, showed a better overall load resistance of about 23% for the AFG preparations compared to the standard ones. In addition, differences in surface area at the corona/prepared-tooth interface were observed in both cases, a measure that would be considered as a stability index for the treated tooth. It was also observed, through the measurement of virtual thickness slices created by the models, that AFG preparations showed more constant and uniform preparation thicknesses.
Conclusion: In this first study emerges that prosthetic restoration on AFG preparations, applied to posterior extracted teeth, showed higher resistance to Von Mises stress compared to a traditional dental preparation. Besides, the AFG preparation design expressed a greater surface area for adhesion and resulted as an easy and predictable technique to obtain a uniform dental preparation thicknesses

Dental Materials

Influence of conditioning protocol on resin cement adhesion to lithium silica-based glass ceramics

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Objective: To evaluate the influence of conditioning with hydrofluoric acid (HF), whether or not followed by the application of silane (S), and Monobond Etch&Prime (EP) on the micro-shear bond strength (μSBS) of RelyX Unicem 2 to VITA Suprinity (ZLS) and IPS e.max CAD (LD).
Materials: ZLS and LD were processed with CEREC InLab MC-XL. Three groups per material were identified with respect to the conditioning protocol: HF, HF+S, EP. In each group (5 milled bars), fifteen specimens (n=15) were prepared for μSBS test building-up RelyX Unicem 2 with a specific device. Data were analyzed using Two-Way ANOVA and Tukey's post-hoc test (p=0.05). Failure modes were assessed using an optical stereo-microscope, classified as adhesive, mixed, cohesive in resin or ceramic, and statistically analyzed using Fisher's Exact Test (p=0.05). One additional bar per group was destined to SEM observation of the conditioned surface.
Results: No significant differences in the adhesion to ZLS and LD were appreciated (p=0.744). Conditioning with EP showed higher bond strengths than HF (p=0.005). No significant differences were recorded comparing EP and HF+S (p=0.107), HF+S and HF (p=0.387). The material-conditioning protocol interaction was not statistically significant (p=0.109). Whether ZLS yielded similar bond strengths under the tested protocols, adhesion to LD was statistically stronger after conditioning with EP rather than HF (p=0.002). No significant differences were recorded comparing EP and HF+S (p=0.443), HF+S and HF (p=0.056). Material and conditioning protocol affected the failure modes distribution (p=0.000 and p=0.017 respectively). ZLS exhibited significantly more mixed failures and less adhesive failures than LD. Mixed failures were statistically more frequent than adhesive failures by conditioning with EP rather than HF and HF+S (p=0.021 and p=0.030 respectively).
Conclusion: As an alternative to the conventional etching protocol with hydrofluoric acid followed by silane priming, Monobond Etch&Prime can be conveniently used to promote adhesion between resin cement and lithium silica-based glass ceramics.

Work Simplification and Management in Prosthodontics

Management of tooth wear: a simple tool to use in the daily practice

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Objective: Tooth wear is a common problem that increasingly affects our patients. The dentist's duty is to diagnose such lesions and understand its causes in order to choose the most appropriate treatment option. It is also important to inform the patient about his/her condition and provide the best preventive solutions.
Materials: The TWM (Tooth Wear Management) folder helps us getting an accurate picture of the situation

because it records all the informations about the patient's oral situation when it comes to the visit. This tool consists of three sections. The first contains the personal data of the patient and a specific medical history questionnaire. The second contains the characteristics of the detected lesions (type, size, location). The third contains a decision table to guide the patient's management.

Results: Consider etiological factors and document the amount of wear is the key to a successful management of the tooth wear. The TWM folder is a simple and useful tool that can be used in the day-to-day practice. All information gathered joined together make it really easy to draw up a diagnosis and therefore a treatment plan. Because tooth wear is typically a dynamic condition this tool is also useful to monitor the patient and subsequently decide whether to formulate a treatment plan or establish a customized prevention program.

Conclusion: Often dentists don't pay attention to non-carious lesions, so they don't take them into account in the treatment plan. However wear lesions are extremely frequent because they can have different etiology. Understand the etiology is necessary to understand how to find the best solution.

Preprosthetic Ortodontics

Effect of occlusal-loading on microgap of implant abutment connection

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Objective: Failure of implant-abutment connections are relatively frequent clinical problems. During chewing and biting, the prosthetic restoration and the implant abutment connection is affected by various physiological forces, e.g on a single molar implant this might be about 120 N in the axial direction. Microgaps between implant and abutment can produce biological and mechanical problems such fatigue failures or adverse biologic responses. Penetration of oral microorganisms through gaps between these components may add to risk of soft tissue inflammation or be responsible for the failure of peri-implantitis treatment. The formation of a marginal gap between the implant and abutment might lead to increased loss of a marginal bone because of the penetration of bacteria into the implant-abutment interface. A literature review of Goodacre in 1999 of clinical complications of osseointegrated implants showed that screw loosening or screw fracture varied between 2% and 45% of the implant restorations, with the highest amount in single crown. A recently published meta-analysis of Pjetursson in 2004 on implant-related complications calculated a cumulative incidence of connection-related complications (screw loosening or fracture) of 7.3% after 5 years of clinical service. Purpose of the study in vitro is to valuate the marginal adaptation of implant abutment Ankylos (Dentsply, Manheim Germany) and Anyone (Megagen, Korea) after mechanical loading (Chewing simulator CS4, Mechatronik, Feldkirchen-Westerham Germany) for 1.200.000 cycles.

Materials: Twelve implants (Anyone Megagen diameter 4.5 mm length 10 mm n=6) and six implant (Ankylos Dentsply diameter 3.5 mm length 11 mm n=6) were embedded perpendicularly in an acrylic resin (Palapress, Heraeus Kulzer, Armonk, NY, USA) with custom-made stainless teflon ring form. The implants were mounted in the resin to mimic oral conditions, where the bone may absorb some forces transmitted to the implant-abutment screw connection. All standard abutments (EZ Plus Megagen diameter 4.5X5.5 mm and Abutment Ankylos regular diameter 4.5X5.0 mm) and were restored with identical single molar crowns. A calibrated electronic implant torque controller (Intrasurg, KAVO, Biberach, Germany) was used to ensure proper seating torque for all abutments following the manufacturer's instruction (35 N/cm for Anyone; 25 N/cm for Ankylos). The crowns were casted in a metal alloy and luted to the abutments with a self-adhesive cement (RelyX Unicem, 3M ESPE, St Paul, MN, USA) to minimize the risk of losing crown retention as comparing to conventional cement. After the implant were embedded, the abutment-crown combination were assembled to the implant with an abutment screw according to the manufacturer's protocol. A calibrated electronic implant torque controller (Intrasurg, KAVO, Biberach, Germany) was used to ensure proper seating torque for all abutments. Occlusal loading and thermocycling of specimens were performed in a CS-4.4 equipment (SD Mechatronik GmbH, Germany) (fig. 1) using a stainless steel antagonist (6 mm diameter), 3.5 mm away from the crown's occlusal center on the tapered occlusal area, for 1.200.000 cycles at 50 N at a frequency of 1 HZ. This dynamic loading contained an additional horizontal sliding motion 2mm rectangular to the implant axis to induce bending moments at the implant-abutment interface. Because of various occurrences of unexpected abutment-screw loosening during the dynamic loading test, the implant-abutment connections were controlled for mechanical integrity at intervals 10.000 chewing cycles. After dynamic loading the abutment-implant connections were analysed with SEM (Quanta 250; FEI, Hillsboro, OR, USA). For evaluation of the microgaps, the implant-abutment systems were embedded in a glycol methacrylate resin. After polymerization, each specimen was sectioned along its longitudinal axis with a low-speed

diamond saw (Micromet; Remet, Italy) under water irrigation. The non-parametric Krustal-Wallis test and the Bonferroni test were used.
Results: A loss of retention between abutment-implant and fracture was assed as a failure.
All specimens no mechanical failure occurred during dynamic loading. The microgap of the implant-abutment connection after mechanical loading were found similar for two systematic implant under Scanning Electron Microscopy (P>0.05).
Conclusion: The marginal quality of implant-abutment after mechanical cycling showed no significant differences between two conical implant abutment. Further clinical research is essential to evaluate if different conical implant-abutment connection designs exhibited significant differences in survival and microgaps under dynamic loading.

Dental Technology and Technical Procedures

The prototype concept in a full digital implant workflow

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Objective: The aim of this study is to describe the innovative concept of the prototype in the digital implant workflow. The prototype was necessary to evaluate the accuracy of the impression, and aesthetic and functional parameters, prior to final framework realisation.
Materials: Three digital impressions were obtained to create a master file, which contained information on the three-dimensional position of the implant, the gingival architecture, and the aesthetic/functional features of provisional restorations. A stereolithographic master model (SMM) featuring implant analogues was 3D-printed. A resin prototype (A) lacking implant connections was produced using the Straumann Digital Workflow process. Standard metal connections were luted into the SMM and tested on the patient. Inaccuracies in prototype A could be attributable to either the impression or to the model. To ascertain where the error lay, a prototype (B) with milled implant connections was produced. The try-in procedure and radiography were repeated but the transparency of the resin compromised accurate investigation. A third uncertified radiopaque resin prototype (C) was prepared using uncertified scanbody and implant libraries, but the accuracy was poor.
Results: Use of a prototype allows the clinician to simultaneously test implant positions and aesthetic/functional parameters. However, a single radiopaque prototype is preferable to determine if an impression is inaccurate even if an uncertified workflow step exerts a negative impact on accuracy.
Conclusion: When inaccuracy is present, only a one-piece radiopaque prototype allows for localisation of the error. The use of uncertified scanbodies and implant analogues is associated with poor accuracy.

Implantology Research

Radiological and histomorphometric outcomes of homologous bone graft in post-extractive implant sites. A 6 years prospective analysis

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Objective: The aim of the present study was to investigate the in vivo efficacy of a cancellous particulate allograft bone in the regeneration of post-extractive atrophic sites.
Materials: 10 patients with 12 molar or premolar teeth to be extracted were selected. After a minimally invasive extraction of the teeth (T0), a TC Cone-Beam was performed (T1). Seven days after extraction, Puros® cancellous particulate homologous graft was inserted into the elected sites together with a membrane (T2). After 4 months, a TC Cone-Beam of the sites was performed (T3). After 5 months, samples of the regenerated sites were taken contextually to implant insertion (T4). The samples were histologically and histomorphometrically analyzed. Intraoral periapical radiographs were accomplished to assess interproximal bone levels at the time of implant placement (T4) and at the 6-year follow-up appointment (T5).
Results: Mean vertical bone augmentation was of 4.1 mm (range 1.9-5 mm) in the lower jaw and of 3.35 mm (range 2.3-4 mm) in the maxilla at T3 appointment. The mean horizontal bone augmentation in the lower jaw was 2.02 mm (range 1.5-2.8 mm) and 2.15 mm (range 1.6-2.8 mm) in the maxilla. According to histomorphometric analysis, at T4 mean total bone was 60.01% (range 25.69-88.49%), the mature bone was 98.41 (range 94.48-99.98). At the 6-year follow-up visit mean peri-implant bone resorption was 0.14 mm (range 0-0.5 mm).
Conclusion: Cancellous particulate allograft bone demonstrated excellent bone regeneration behavior both in terms of quantity and quality, and stable results over a 6 years period.

Fixed Prosthesis

Clinical evaluation of lithium disilicate restorations: A 7 years retrospective study

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Objective: An increasing amount of studies reported the general use of lithium disilicate for both anterior and posterior single crowns. A recent study found that anterior and posterior lithium disilicate restorations, with a mean follow-up of 3 years, showed success rates ranging from 95.39% to 100%. A review concluded that lithium disilicate single crowns showed excellent short-term survival rates, even if the evidence for medium-term survival is limited. Aim of this retrospective study was to assess the clinical performance of lithium disilicate single restorations on natural teeth over a maximum period of 7 years.
Materials: Between 2009 and 2016, 46 patients received 75 lithium disilicate single restorations at the Dental Clinic of the University of Ferrara. All the patients were recalled for clinical evaluation by a trained examiner following a form specifically designed for all-ceramic restorations. Any mechanical complications were reported.
Results: Fifty-seven partial and total restorations in 28 patients were evaluated from a minimum of 3 months to a maximum of 81 months. The mean follow-up was of 42 months. The cumulative survival rate was 98.2%, the cumulative success rate was 94.7%. Only 3 mechanical complications were found: a major complication (fracture of the ceramic core) and two minor complications (chipping).
Conclusion: Within the limits of the study, lithium disilicate can be successfully used for single total and partial restorations on natural teeth. Further in vivo investigations are required to confirm the clinical reliability of lithium disilicate restorations in the long-term and for extensive restorations (e.g. bridges).

Fixed Prosthesis

Manufacturing of metal frameworks for full-arch dental restoration on implants: a comparison between the milling technique and a novel hybrid sint/mill technology

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Objective: Minimal misfit between implant heads and the framework platform of a full-arch prosthesis is mandatory to reduce strain and stress during attachment. Implant-supported frameworks are generally manufactured from solid metal blocks using a time-consuming subtractive milling procedure. A novel alternative method is selective laser melting/milling (SLM/M), which uses the more efficient SLM technology to fabricate the whole prosthesis framework. Thus, only the implant connecting surfaces are machined using a conventional milling procedure. Although the SLM/M technique is more cost effective and rapid than conventional milling, data concerning its manufacturing accuracy are lacking in the dental literature. Thus, the aim of this study was to determine the accuracy of frameworks manufactured with SLM/M and conventional milling, by comparison with the original computer-aided design (CAD) framework.
Materials: Based on a clinical case, a virtual 6-implant-supported full-arch framework was designed using CAD technology. The virtual framework was used to manufacture a total of 27 titanium clones at three independent manufacturing centers (n = 9 for each manufacturer) using the hybrid SLM/m technology (Lab 1 and Lab 2), and the conventional milling technique (Lab 3). The error between the implant connecting geometries of the CAD framework and those of the real titanium framework was calculated as a 3D error given by the x, y, and z axes measurements. The positioning misfit between all the possible couples of the implant connecting geometry within each framework was also evaluated for each group. In vitro measurements of the titanium prostheses were performed using a metrological approach with an optomechanical coordinate measuring machine. CAD-based reconstruction of the actual connecting geometries was performed, and error analysis was conducted to determine manufacturing inaccuracies.
Results: When compared to the virtual CAD framework the accuracies showed by the 3 groups as a 3D positioning error of the implant connecting geometries were statistically different, with the milled group appearing the least accurate (p= 0.005). The mean errors ranged from 8–16 µm and 9–22 µm for SLM/m technique (Lab 1 and 2, respectively), and 20-35 µm for conventional milling (Lab 3). No significant differences were detected between the frameworks obtained with the two SLM/m hybrid technologies groups (Lab 1 and Lab 2). As regards the positioning misfit between all the

possible couples of the implant connecting geometries within each framework, no significant differences were observed among the groups: the mean errors were 1–25 µm and 1–38 µm for SLM/m groups (Lab 1 and 2), and 2–63 µm for the milling technique (Lab 3). In all groups the misfit increased with the distance between the considered implant connecting geometry couple.

Conclusion: The two SLM/m groups (lab 1 and 2) and the milled group (Lab 3) showed 3D misfits well within the error limits reported in the literature. However, both hybrid (SLM/m) technologies used to make a full-arch implant-supported FPD showed a significantly higher accuracy when compared to the conventional milling technique. Further studies are necessary to confirm these data and to establish if this difference might actually influence the clinical outcome of the rehabilitation, considering that the maximum mean error of the milled group was below the 50 µm threshold. Since in all groups the highest errors were measured between the most distant implants, a correlation between the framework span and the inaccuracies generated by both hybrid and milling manufacturing is expected.

Fixed Prosthesis

Fracture resistance and periodontal response of single porcelain fused to zirconia crowns with either knife edge or chamfer margins

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Objective: The present prospective clinical study aimed at evaluating the influence of margin finishing lines on the fracture resistance and periodontal response of CAD/CAM zirconia single crowns layered with dedicated ceramics.

Materials: Fifty patients were provided with 50 zirconia single crowns in posterior regions. Tooth preparations were standardized and the abutment teeth were randomly distributed into 2 groups, according to 2 different finishing lines: Group 1 vertical prep (VP); Group 2 horizontal prep, chamfer (HP). Anatomical design was selected for all the zirconia single copings. The zirconia copings (Aadva Zirconia, GC) were produced using a CAD/CAM software (Aadva lab scanner + Exocad platform) and then hand-layered with dedicated ceramics. All the crowns were cemented with a glass ionomer luting agent and the patients were recalled for follow-up visits after 1 month, 6 months, 1, 2, 3, and 4 years. Function, esthetics, marginal adaptation and periodontal parameters such as BoP, PD, distance of margins from bone crest were recorded at 4-year follow-up. Statistical analyses were performed to evaluate survival and success of the restorations. A logistic regression analysis was applied to verify whether 4-year bleeding on probing at the interproximal level was significantly influenced by tooth type, preparation type, and distance of preparation margin from bone crest level. A separate logistic regression analysis was performed to assess whether 4-year bleeding on probing at the buccal level was significantly influenced by tooth type and preparation type.

Results: Group 1: Success 21/25; survival 25/25; (one not reparable fracture of ceramic layer); Group 2: Success 20/25; survival 25/25. Success rates of 80% were reported in Group 1 and of 76% in Group 2; all the crowns of Group 1 and Group 2 survived at 4-year follow-up resulting in an overall survival rate of 100%. Four chippings were noticed in Group 1 (FD), but only 1 crown needed to be replaced after 4 years. In Group 2 five chipping were noticed but no need for replacement after 4 years of clinical service. Statistical analysis did not show any statistically significant difference in regards to survival and success rates. The first regression analysis revealed that for bleeding on probing at the interproximal level preparation type ($p=0.004$) and distance of preparation margin from bone crest level ($p<0.001$) were statistically significant factors, while tooth type did not have a significant influence ($p=0.821$). The second regression analysis disclosed that for bleeding on probing at the buccal level neither preparation type ($p=0.721$), nor tooth type ($p=0.399$) was a significant factor. Regarding the periodontal parameters of BoP, it was found bleeding in 12 of the 25 crowns of Group 1 (48%) and in 18 of the 25 crowns of Group 2 (55,5%). There were no statistically significant differences between the two groups with regard to BoP. However a statistically significant correlation between BoP and the distance of the margin to the bond crest was found: when the bone crest was closer than 3 mm, a higher probability of BoP was recorded.

Conclusion: According to the results of the present in vivo study, the following conclusions can be drawn:
- after 4 years of clinical service, zirconia crowns cemented on teeth prepared with either vertical or horizontal margins did not show any differences in regards to survival rate and success rate;
- similarly, the type of finishing line did not influence the analyzed periodontal scores;
- the distance from the restorations margin to the bone crest influenced BoP.

Fixed Prosthesis

RCT on clinical performances of LiSi Press vs e.max: 20-month recall

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Objective: To evaluate clinical parameters of lithium disilicate onlays luted with proprietary bonding-luting materials after 2 years of clinical service.
Materials: One hundred restorations were placed in no less than 50 patients in need of one or two single partial crowns. Subjects were recruited from the pool of patients attending the department of Prosthodontics and Dental Materials of the University of Siena. Patients' written consent to the trial was obtained after having provided complete explanation of the aim of the study. Ethical approval was obtained a priori. Fifty restorations were made with LiSi Press (GC; Group 1) and 50 with IPS e.max (Ivoclar; Group 2). Preparation design provided at least 0.5-1 mm space at the margin and 1.0-1.5 mm occlusally. Margins were placed mainly into enamel (only interproximal box may have cervical margin on dentin-cementum). At least one cusp was covered. Inclusion criteria: males and females, aged 18-70 years, in good general and periodontal health and in need for at least one or two restorations on vital posterior teeth (molars and premolars) were included. Exclusion criteria: patients with the following factors were excluded from the clinical trial: minors (<18 years); pregnancy; disabilities; potential prosthodontic restoration of the tooth; teeth with signs of pulpal inflammation, non-vital or endodontically treated teeth; (profound, chronic) periodontitis; deep lesions (close to pulp, <1 mm distance) or pulp capping; heavy occlusal contacts or history of bruxism; systemic disease or severe medical complications; history of allergy to methacrylates; rampant caries; xerostomia; lack of compliance; language barriers; plaque index > 20. Clinical Procedure: For standardization purposes, only 1 operator per office performed all the clinical procedures in that specific center. Following anesthesia, rubber dam was placed, caries was excavated, and any restorative material was removed. The teeth were prepared using conventional diamond burs in a high-speed hand-piece, without bevel on the margins. The preparation design was dictated by the caries extent, pre-existing restorations and the preparation guidelines defined by the manufacturer of the respective restorative materials. The Residual Dentin Thickness (RDT) was evaluated on a periapical radiograph, and teeth with RDT thinner than 0.5 mm were excluded. After preparation, an impression of the prepared tooth was taken and sent to the laboratory. A temporary restoration was made for each abutment and one week later, the ceramic restorations were luted following the manufacturer's instructions using the proprietary adhesive and cement (Group 1: G-Premio Bond+LinkForce and Group 2: AdheSE Universal+Multilink Sprint) after sandblasting, etching with 10% hydrofluoric acid for 30 seconds and application of Resin Primer and Monobond Plus, respectively. The restorations were placed in the time period between July 2015 and March 2016 and examined for post-operative sensitivity at baseline, at the cementation (approximately 1 week), 1-2 weeks and after 6 and 12 months by the same operator. At each recall, data regarding post-operative sensitivity, stability and longevity were collected in accordance with the USPHS criteria. The following parameters were assessed: Post-operative sensitivity: patient's comfort with the restoration in function, cold and warm stimuli, and a gentle air stream was assessed. Sensitivity was defined on a scale from 0-10. The other evaluated clinical parameters were: marginal discoloration and integrity, secondary caries, fracture, vitality, retention and interproximal contacts. After 1, 2 and 3 years of clinical service, the restorations were re-evaluated for the above described clinical parameters and radiographically. Failures were classified as: fracture/chipping of the material, endodontic failure, debonding. All data were collected and evaluated statistically.
Results: The results of post-operative sensitivity are reported in Tables 1-2. There were no statistically significant differences, even though there were no failures in Group 1 at 24-month recall, while in 3 teeth from Group 2 mild sensitivity was reported and one tooth needed to be endodontically treated and was consequently excluded from the trial after 8 months of clinical service.
Conclusion: In this study, no failures due to esthetic and/or mechanical issues were recorded when lithium disilicate crowns were luted in combination with their proprietary bonding-luting materials. Post-op sensitivity might be an issue in Group 2, even though no statitically significant differences were found.

Criteria and number of restorations evaluated after 24 months	Group 1	alpha	bravo	charlie	delta
Marginal discoloration and integrity	50	50	0	0	0
Secondary caries	50	50	0	0	0
Vitality test	50	50	0	0	0
Crown integrity	50	50	0	0	0
Retention	50	50	0	0	0
Fracture	50	50	0	0	0
	NO	YES	Mean	SD	
Post-operative sensitivity	50	50	/	/	/

Criteria and number of restorations evaluated after 24 months	Group 2	alpha	bravo	charlie	delta
Marginal discoloration and integrity	49	49	0	0	0
Secondary caries	49	49	0	0	0
Vitality test	49	48	0	0	1
Crown integrity	49	49	0	0	0
Retention	49	49	0	0	0
Fracture	49	49	0	0	0
	NO	YES	Mean	SD	
Post-operative sensitivity	49	46	3	/	/

Fixed Prosthesis

Post-Operative sensitivity of e.max vs LiSi Press onlays: a 20-month recall

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Objective: To evaluate post-operative sensitivity of lithium disilicate onlays luted with their proprietary bonding-luting materials after 2 years of clinical service. **Materials:** Sixty restorations in 30 patients in need of one or two single partial crowns were placed. Subjects were recruited from the pool of patients accessing the department of Prosthodontics and Dental Materials of the University of Siena. Patients' written consent to the trial was obtained after having provided a complete explanation of the aim of the study. Ethical approval was obtained a priori. Thirty restorations were made with LiSi Press (Group 1, GC) and the other 30 using IPS e.max (Group 2, Ivoclar). Preparations provided at least 0.5-1 mm space at the margin and 1.0-1.5 mm occlusally. Margins were mainly located in enamel (only interproximal box might have cervical margin on dentin-cementum). At least one cusp was covered. All teeth were tested for vitality. Inclusion criteria: males and females, aged 18-70 years in good general and periodontal health, in need for at least one or two restorations on posterior teeth were included (molars and premolars). Exclusion criteria: patients with the following factors were excluded from the clinical trial: minors (<18 years); pregnancy; disabilities; potential prosthodontic restoration of the tooth; teeth with signs of pulpal inflammation, non-vital or endodontically treated teeth; (profound, chronic) periodontitis; deep defects (close to pulp, <1 mm distance) or pulp capping; heavy occlusal contacts or history of bruxism; systemic disease or severe medical complications; history of allergy to methacrylates; rampant caries; xerostomia; lack of compliance; language barriers; plaque index >20. Test stimuli and assessment: before applying the adhesive material, pain was measured was performed utilizing a simple pain scale based on the response method. Response was determined after a one second application of air from a dental unit syringe (at 40-65 p.s.i. at approximately 20°C), directed perpendicularly to the root surface at a distance of 2 cm and by tactile stimuli with a sharp #5 explorer. The patient was asked to rate the perception of the sensitivity experienced by placing a mark on a visual analog scale or line beginning at 0 and ending at 10 (where 0 = no pain and 10 = excruciating pain). A score of 0 was defined as no pain, 1-4 as mild sensitivity (which was provoked by the dentist's air blast), and 5-10 as strong sensitivity (which was spontaneously reported by the patient during drinking and eating). Only patients scoring low on the analog scale were included in the study, whereas high score cases were excluded by the assumption that irreversible pulp inflammation may be sustaining the high sensitivity. The status of the gingival tissues adjacent to the test sites was observed at baseline and at each recall. Patients were recalled at our department for testing post-operative sensitivity after 2 weeks, 6 months, 1 and 2 years. Clinical Procedure: For standardization purposes, only 1 operator per office performed all the clinical procedures in that specific center. Following anesthesia, rubber dam was placed, all carious structures were excavated, and any restorative material was removed. Teeth were prepared using conventional diamond burs in a high-speed hand-piece, with no bevel on margins. The preparation

design was dictated by the caries extent, pre-existing restorations and the preparation guidelines defined by the manufacturer of the restorative materials. The Residual Dentin Thickness (RDT) was evaluated on a periapical radiograph, and teeth with RDT thinner than 0.5 mm were excluded. Dentin was sealed using the adhesive and the deepest part of the cavity was built up with a proprietary flowable resin composite (G-ænial Universal Flo, GC and Tetric Flow, Ivoclar, respectively) and the cervical margin was relocated when needed. After preparation, an impression of the prepared tooth was taken and sent to the laboratory. In the lab, the disilicate crowns were made strictly following manufacturers' instructions. A temporary restoration was made and one week later, the restorations were luted following the manufacturer's instructions using the proprietary adhesive and luting materials. In Group 1, LiSi onlays were luted with G-Premio Bond in combination with G-CEM LinkForce resin cement after sandblasting, etching with 10% Hydrofluoric acid for 30 seconds and application of Resin Primer for 1 minute. In Group 2, IPS e.max onlays were luted with AdheSE Universal in combination with Multilink Sprint after sandblasting, etching with 10% hydrofluoric acid for 30 seconds and applicaton of Monobond Plus for 1 minute. The restorations were placed in the time period between September 2015 and January 2016 and examined for post-operative sensitivity at baseline, after 1 week, 1 month and after 6, 12 and 24 months by the same operator.

Results: The results of post-operative sensitivity are reported in Tables 1-4. There were no statistically significant differences even though no sensitivity was reported in Group 1 at the 24-month recall, while in Group 2, mild sensitivity in two teeth was reported.

Conclusion: When lithium disilicate crowns were luted in combination, with their proprietary bonding-luting materials, there was almost no post-operative sensitivity after 24 months of clinical service.

Sensitivity before placing the restorations	Group 1	No	Yes	Mean	SD
Tooth sensitivity		24	6	1.8	1.5
Scores of the 8 sensitive teeth		2,2,2	3,4,2		

Sensitivity before placing the restorations	Group 1	0	1-4	5-10
1 week	30	27	3	0
1 month	30	28	2	0
6 months	30	28	2	0
12 months	30	30	0	0
24 months	30	30	0	0

Sensitivity after placing the restorations	Group 2	0	1-4	5-10	SD
Tooth sensitivity		22	8	2.2	1.8
Scores of the 8 sensitive teeth		3,4,1	2, 2,	2,3,3	

Sensitivity after placing the restorations	Group 2	0	1-4	5-10
1 week	30	26	4	0
1 month	30	27	3	0
6 months	30	26	4	0
12 months	30	27	3	0
24 months	30	28	2	0

Fixed Prosthesis

Two years post-operative sensitivity and clinical performances of single porcelain-fused-to-zirconia crowns with chamfer vs. knife edge margins

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Objective: To evaluate the clinical performances of porcelain-fused-to-zirconia crowns with two different finishing margins (chamfer vs. knife edge) after two years of clinical service.

Materials: Sixty restorations were placed in 30 patients in need of one or two single partial crowns. Subjects were recruited from the pool of patients attending the department of Prosthodontics and Dental Materials of the University of Siena. Patients' written consent to the trial was obtained after having provided a complete explanation of the aim of the study. Ethical approval was obtained a priori. Sixty teeth were randomly divided in two groups of 30 samples each: Group 1: chamfer finishing line; Group 2: knife edge finishing line. A standardized preparation was performed with occlusal and axial reduction of 1.5 mm and a chamfer or knife edge finishing line intracrevicularly (0.5 mm into the sulcus) on the buccal margin and iuxtagingivally on the interproximal and lingual margins. Preparations provided at least 0.5-1 mm space at the margins and 1.0-1.5 mm occlusally. All margins were in dentin-cementum. Dentin was sealed using a universal bonding

system (G-Premio Bond, GC). After preparation, an impression of the prepared tooth was taken and sent to the laboratory. In the lab, the zirconia crowns were made strictly following manufacturers' instructions. The crowns were designed using Aadva lab scanner (GC) and Dental CAD software (Exocad). The crowns were made on Zirconia Aadva (GC) and luted with G-CEM LinkAce (GC). A temporary restoration was made and luted with eugenol-free temporary cement and within two weeks, the restorations were luted following the manufacturer's instructions using G-CEM LinkAce. The restorations were placed in the time period between April 2015 and July 2015 and examined for post-operative sensitivity at baseline, after 1 week, 1 month and after 6, 12 and 24 months by the same operator. The values were analyzed with the one-way ANOVA; in order to verify whether statistically significant differences were found among the experimental groups, the Tukey's post hoc test with Bonferroni's correction was applied. In all the analyses the level of significance was set at $\alpha = 0.05$.

Results: The results of post-operative sensitivity are reported in Tables 1-4. There were no statistically significant differences; no post-operative sensitivity was found in Group 1 and Group 2 after 24 months of clinical service. Also, no chipping was recorded in either group after 24 months of clinical service. 100% clinical success was recorded.

Conclusion: The type of finishing line (chamfer vs knife edge) of zirconia crowns did not influence post-operative sensitivity and clinical performances after 24 months of clinical service. Consequently, both chamfer and knife edge finishing lines are reliable and predictable when zirconia material is used.

Sensitivity before placing the restorations	Knife edge 30	No	Yes	Mean	SD
Tooth sensitivity		22	8	3.0	1.0
Scores of the 8 sensitive teeth		1,2,2	3, 4, 3	1,2	

Sensitivity before placing the restorations	Chamfer 30	No	Yes	Mean	SD
Tooth sensitivity		23	7	2.5	1.0
Scores of the 8 sensitive teeth		2,2,2	3, 4, 2	1	

Criteria and number of restorations evaluated after 24 months s	Knife edge	alpha	bravo	charlie	delta
Marginal discoloration and integrity	30	30	0	0	0
Secondary caries	30	30	0	0	0
Vitality test	30	30	0	0	0
Crown integrity	30	30	0	0	0
Retention	30	30	0	0	0
Fracture	30	30	0	0	0
	NO	YES	Mean	SD	
Post-operative sensitivity	30	30	/	/	/

Criteria and number of restorations evaluated after 24 months	Chamfer	alpha	bravo	charlie	delta
Marginal discoloration and integrity	30	0	0	0	0
Secondary caries	30	0	0	0	0
Vitality test	30	0	0	0	0
Crown integrity	30	0	0	0	0
Retention	30	0	0	0	0
Fracture	30	0	0	0	0
	NO	YES	Mean	SD	
Post-operative sensitivity	30	/	/	/	/

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Influence of cervical margin relocation (CMR) on periodontal health: preliminary results of a controlled trial

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Objective: Cervical Margin Relocation consists on placing a base of direct resin composite to elevate the proximal underneath indirect bonded restorations. The aims of this clinical study were to evaluate BoP on posterior indirect restorations with one interproximal margin relocated cervically, and possible correlation between depth of the interproximal margins and Bleeding on Probing (BoP).
Materials: Cervical relocated margins (CMR, Group 1) and shoulder preparations (Group 2) were placed in 35 posterior teeth and evaluated after 12 months (T12). Cavities' margins were placed below the CEJ. In one proximal box CMR procedure was performed using G-Premio Bond, for dentin hybridization, and universal flow resin composite (GC Co. Tokyo, Japan). Pressed lithium disilicate crowns (LS2) (LiSi Press, GC Co.) were made and luted with proprietary luting material. At baseline and after 12 months, the restorative margin position in relation to the gingival margin was recorded quantifying it in mm by probing and also the distance from the bone crest was calculated. Statistical analysis was performed.
Results: CMR was associated with statistically significant increased scores for BoP. Gingival Index (GI) and Plaque Index (PI) were not statistically different between the groups. At the end of the experimental period, 53% and 31.5% of sites (Group 1 and 2 respectively) were positive to BoP: this difference was statistically significant ($p=0.10$). The linear distance between the bone crest and the restorative margin, assessed by a radiographic analysis, was 2 mm in 13 out of 19 experimental sites of group 1 and 6 out of 11 of group 2.
Conclusion: Within the limitations of this study, higher incidence of BoP can be expected around CMR margins and in coincidence with deep margins placed at or closer than 2 mm from bone crest.