

Complete-arch Implant-supported Composite Pressed Restorations Fixed Dental Prosthesis

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The aim of this study was to evaluate the clinical performance of the composite pressed on metal framework for full-arch implant-supported fixed prosthesis in order to eliminate the drawbacks related to the chipping of porcelain fused to metal or to zirconia restorations. Sixteen patients received 22 implant-supported screw-cement-retained complete-arch restorations, consisting of composite pressed restorations. All patients were follow-up visit up to 2 years on function (range 24 to 30 months, mean 28.3 months). The outcomes were implant and prosthetic survival rates and calculations of wear determination (μm). After two years of function, the wear values were $95.54 \pm 6.88 \mu\text{m}$ on pressed composite restoration. Using composite pressed restorations appears to be a predictable, esthetic and successful treatment option for method of full arch restorations over implants.

Keywords: wear determination, screw-retained implants restorations, pressed composite restorations, survival rates.

Full arch Implant-supported restorations have become a common treatment choice for most of the dental practitioners. Their predictability has been documented to have high success rates [1-6]. Many combinations of materials have been used for this type of restorations such as metal alloy-acrylic, metal alloy-composite, and metal alloy-ceramic [1, 7]. Recent study [8], monolithic zirconia restorations have received attention as an alternative to zirconia veneered with feldspathic porcelain to eliminate chipping failures of veneer ceramics. Dental zirconia has excellent physical properties but is need to prevent excessive stresses on the zirconia cylinders when a screw-retained zirconia restoration is planned as a definitive prosthesis. The composite pressed restorations are a treatment option for full arch restorations over implants, showing a better success rate in comparing with ceramic restorations [7].

A wide variety of polymeric materials are available to make satisfactory implant restorations, but the ideal material has not been developed yet. A major problem still need to be solved is dimensional change during solidification. These materials shrink and cause discrepancy, especially when the direct technique is used. Another problem is exothermic reaction during curing, and the presence of residual toxic monomer, which makes these materials less biocompatible [9]. Direct interim veneers made of dimethacrylate composite resins showed good anatomic configuration, good marginal adaptation, no discolorations, no fractures, no postoperative pain and no sign of periodontal inflammation [10]. The dimethacrylate composite resins permit modification of interim veneers and therefore the final restorations are customized according to patient feedback. However, complications including fractured or debonded acrylic resin teeth, wear of surfaces, chipping, difficulty in shade matching of acrylic and pink ceramic, lack of passive fit, and extensive work

for repair after framework breakage have encouraged dentists to look for other material options [2, 8]. The use of composite pressed restorations is an option that has been proposed [7].

Dental composite resin is a particle-dispersed composite with a sea-island structure of organic resin and inorganic filler, which has a long track record of clinical application as an esthetic filling and restorative material [11, 12]. Nano-materials are present in many products. Tooth pastes already contain nano-particles like hydroxyapatite but nano-silver is the most common material in the database, with 383 products listed [13]. Based on its high flexural strength and high fatigue resistance, a nano-ceramic ceramic particle reinforced composite is ideal for challenging cases like implant supported crowns and wear resistant [14]. Further research is required to evaluate the long-term outcome of CAD/CAM composite restorations.

The surface structure of acrylic resins as well as composite resin and ceramic are a favorable environment to the bacterial plaque development. Diacrylic composite resins have superior mechanical and aesthetic properties but are inferior to ceramics. The oral cavity health depends on correct prosthetic treatments and a balanced microbial flora that can be controlled with bacteriostatic substances, oral hygiene and correct prosthetic restorations. Bacteriostatic effect of silver nano-particles over plastic dental materials may influence and contribute to the activity of bacterial micro-flora and may influence the evolution of periodontal disease and gingivitis by destroying the dental plaque [15].

The purpose of this study was to evaluate the clinical performance and wear abrasion of composite pressed for full arch implant supported restorations and report it the rate up to 2 years after function.

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Experimental part

This clinical study was conducted in the Dental Implantology Clinic, in Timisoara, Romania from March 1, 2015 to October 31, 2017. Patients who requiring full arch fixed reconstruction (excluding overdentures) in maxilla, mandible, or both were consecutively selected. The patients were aged 18 years or older and are able to understand and sign written informed consent forms were eligible for this study. Sixteen patients with twenty-two implant supported restoration that fit the inclusion criteria agreed to participate in the study. Only one operator (EB) performed all the surgeries to minimize the bias. In all cases the patients received temporary implant-supported restorations after the insertion phase (fig. 1).

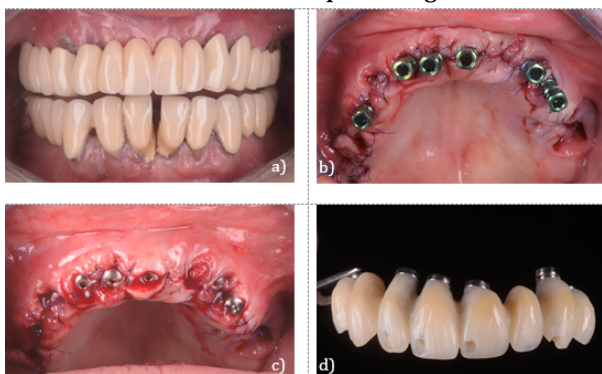


Fig. 1. Clinical documentation of the implant insertion and provisional: a) Initial status; b) implants inserted in the maxillary after extractions; c) positioning healing screw until provisional; d) temporary acrylic full-arch restoration fabrication at 1 day after surgery

Three months after the implant insertion phase, a second surgical phase was performed to uncover the implants where the immediate loading was avoided. New provisional or healing screws were placed onto the implants (fig. 2). Four weeks after the implants were uncovered, impressions were taken utilizing a direct-transfer technique using polyether material (Impregum Penta L DuoSoft, 3M ESPE, US) after a preliminary impression with polyvinilsiloxane (fig. 3). Prosthetic restorations were

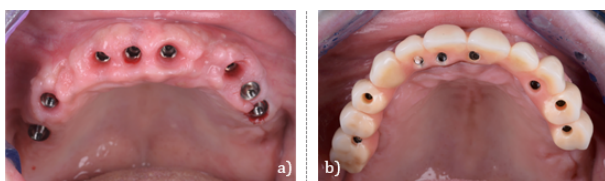


Fig. 2. a) clinical appearance of the crest after 3-month osteointegration period; b) all implants uncovered and new temporary acrylic full-arch restoration

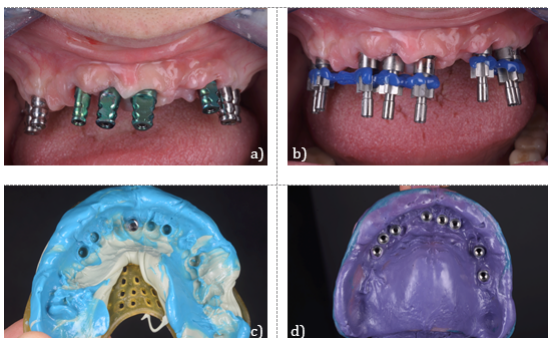


Fig. 3. After four weeks from the implants were uncovered an impressions were taken utilizing: a, c) preliminary impression with indirect transfer technique for obtaining a custom try b, d) final impression with direct-transfer technique solarized in oral cavity

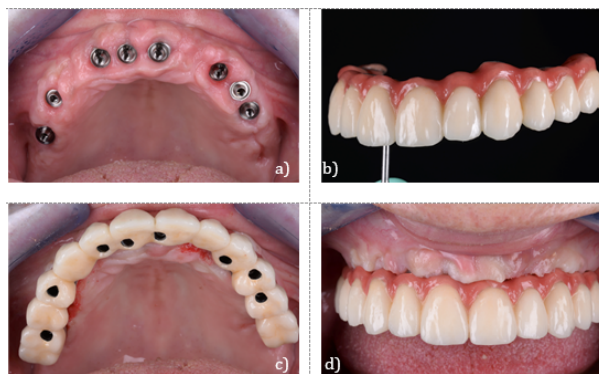


Fig. 4. Clinical aspects in the day of fixation: a) multi-unit after provisional removed; b) Implant screw-retained full-arch fixed pressed composite restoration; c) occlusal view of pressed composite in oral cavity; d) frontal view of pressed composite in oral cavity

delivered 5 weeks after second stage surgery (fig. 4). All patients received screw-retained or cement implant-supported restorations. The laboratory procedures for composite pressed restorations were performed according composite press technique (Nexco® Flask, Ivoclar Vivadent, Liechtenstein). The screw-retained restorations or standard abutment were fixed to the implant with the torque of 25 N/cm.

Recall appointments were performed at 12 and 24 months after insertion. All appointments are required for clinical examination.

Outcome measures

In order to determine the wear, in all cases digital impressions were obtained, after the restorations were fixed. All arches were scanned with a 3D Scanner Design System (Planmeca, Planscan, Helsinki, Finland) recording the anatomical surfaces of the intra-oral restorations (fig. 5 a). First scan was made in the same day with the fixation of the implant-supported restoration (baseline), a second one after one year and a third scanning at two year of function (fig. 5 b, c, d). The Planmeca design software has a high-resolution charge-coupled device (CCD), mobile axes and measuring points. Therefore the baseline scan images could be superimposed over each of the successive annual images. Three reference points were used for an accurate comparison of the 3 images obtained from every patient. Wear amounts (μm) were calculated as the maximum loss in height of the occlusal surface. Reported wear data were determined from baseline to 2 years.

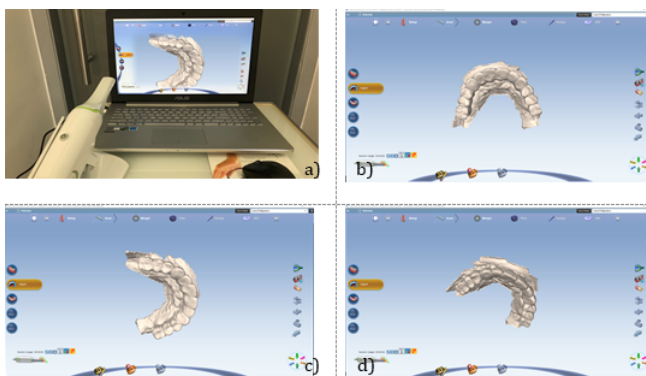


Fig. 5. Using 3D Scanner Design System for analyzing wear in all cases: a) arches were scanned with a digital scanner Planmeca and recording the anatomical surfaces of the restoration; b) first scan made in the same day with the fixation of the implant-supported restoration (baseline), c) second after 12 months d) third scanning at 24 months of function.

The operator (SM) was eligible for inclusion because he had at least 3 years of clinical experience with CAD/CAM systems, agreed with the intervention protocol, and handled all the cases.

Statistical analyses were appropriate to the nature and distribution of the data collected. The unit of analysis was the composite pressed implant restoration individually for each arch. Categorical data were described in tables and the results are given as mean, standard deviation, minimum and maximum of measured data. All statistical calculations were performed using one-way ANOVA (statistical analysis of variance) with the operating system Apple OS X Yosemite version 10.10.3. The level of significance was set to $p < 0.05$.

Results and discussions

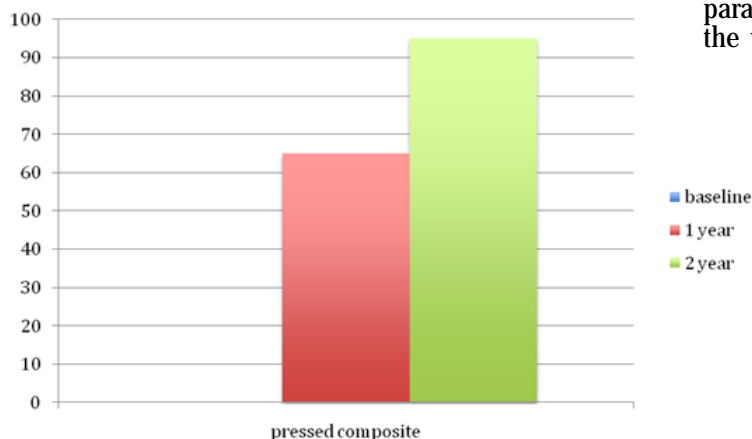
In total, 22 pressed composites full-arch implant restorations were scanned in this study. No implant failures or complications were reported for an implant survival rate of 100%. All the patients were followed up for at least 2 years for function (range 24 to 30 months, mean 28.3 months). The overall implant and prosthesis survival rates at 2 years were 100%. Soft tissue parameters were found around all the implants. No filling of pressed composite showed any problems it like discolorations, chipping or any alterations.

The effects of tested and controlled modalities of the pressed composite restorations are present in table 1.

Table 1
WEAR RESULTS IN μm AFTER 1 YEAR AND 2 YEAR FOR PRESSED COMPOSITE FOR COMPLETE-ARCH IMPLANT-SUPPORTED RESTORATIONS

| Visit | Composite pressed restorations | | |
|--------|--------------------------------|-----|-----|
| | Mean \pm SD | min | max |
| 1 year | 64.96 \pm 6.37 | 42 | 84 |
| 2 year | 95.54 \pm 6.88 | 67 | 231 |

Consequently, the calculations of wear (μm) were performed for all the pressed composite restoration. After two years of follow-up the wear values were $95.54 \pm 6.88 \mu\text{m}$ for pressed composite fillings (fig. 6). One-way ANOVA shows no significant differences among the vertical loss ($p < 0.001$). The highest wear was observed on the occlusal contact points in static and dynamic occlusion on the patient with parafunctions, up to $231 \mu\text{m}$ after two years of follow-up.



Wear is a mechanical process and is determined by several factors. The mechanical properties of a material are not the only factors responsible for wear. The composition and size of the fillers as well as the matrix also have a direct effect on wear. Of no less importance is also the role played by the polishing properties and surface roughness of the material.

The results of this clinical research indicate that the pressed composite implant restorations studied offered a restorative option with low abrasive wear potential and high esthetics for a long period of time. The fabricating of an implant-supported restoration includes many clinical and laboratory processes and a series of decisions regarding the implant components, materials, and the retention method. Both screw- and cement-retained reconstructions have their limitations and advantages; therefore the clinician has to select the adequate retention type according to each clinical case.

Various methods are employed to simulate clinical wear (attrition, abrasion and fatigue) in the lab. Two-body wear testing, performed in a chewing simulator without the addition of an abrasive medium, has become the established method of measuring wear. If this method is used, plane samples are subjected to 120,000 chewing cycles at a frequency of 1.6 Hz and a load of 50 N. An antagonist consisting of an artificial cusp made of IPS Empress ceramic moves across the occlusal surface of the test material along a gliding path of 0.7 mm. Simultaneously, the samples are subjected to thermocycling (at 5 and 55 °C). Maximum vertical wear is quantified with a laser scanner [16]. Similar with this in-vitro study in our study we scanned for accuracy with a intraoral scanner for obtaining digital 3D models.

Utilizing composite [17] in fixed prosthetic restorations registered less stress in the tooth restored, compared with ceramic materials. This stress has recorded higher values if the tooth was restored through a composite inlay than in case of the tooth restored through a ceramic inlay. There are the same problems also with the implant, that we found in the present study.

The surface roughness of composite resins was studied in a relevant article [18] and is in relation with the type of composite resin and the type of finishing and polishing system. The one-step diamond abrasive polisher was more efficient in obtaining smooth surface when comparing to tungsten carbide burr or diamond burr. After finishing and polishing, the nanohybrid composite resin had lower surface roughness when compared to microhybrid and the hybrid composite resin. On this way, the pressed composite is more compact and the surface is smooth.

A study [19] analyses the influences on a mechanical behavior that appear in bars reinforced with carbon fibers fabric, and respectively carbon-kevlar fibers. The main parameters which influence the uniformity coefficient are the volumetric proportion of reinforcement in zone of

Fig. 6. Comparison of wear in μm between 1 year and 2 years with pressed composite restorations for restore full arches.

minimum resistance, the volumetric proportion of reinforcement in rest of the material, the zone size of minimum resistance and the ratio between the elasticity modulus of fibers and elasticity modulus of matrix. In addition, it is observed that the elongation at break is proportional to the uniformity coefficient, and their ratio does not depend by the number of discontinued layers. This fact can be explained by composites behaviour, which is practically linear until the fracture.

The most common complication in the field in the literature was tooth chipping in the opposing maxillary denture, which accounted for 50% of all complication events [20-23].

It is important to note that full arch restorations required prosthetic approach for long term stability. By using this method that was described in this article we can avoid chipping or any complication in veneering fracturing.

Conclusions

A pressed composite restoration with a metal framework structure can diminish chipping of the veneered porcelain. The outcome of the present study showed a normal abrasion with high success in function, aesthetics, and high patient satisfaction. Some of the benefits are force absorbing, implant bone reabsorption, and minimal occlusal adjustments.

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