Zirconia-Reinforced Lithium Silicate Ceramic - A 2-Year Follow-up of a Clinical Experience with Anterior Crowns

Keywords

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ABSTRACT

The aim of this manuscript is to describe 2-year follow-up of a clinical experience with a zirconia-reinforced lithium silicate ceramic for an anterior rehabilitation with single metal-free crowns. The maxillary-central incisor teeth crowns were made by zirconium-reinforced lithium silicate and covered with porcelain were obtained with a digital impression with the intra-oral scanner of the CEREC system as a basis for virtual design, as well as a laminate for the left lateral maxillary incisor, based on a "double scanning" technique. Lithium silicate material seems to be a safe and satisfactory alternative for anterior crowns' rehabilitation.

INTRODUCTION

Ceramic restorations are used extensively in esthetic rehabilitations due to their clinical performance, durability, and excellent mechanical and chemical properties.[1-7] In recent years, researchers have been developing ceramic materials[6,8-11] in special for anterior rehabilitation, as they usually result in chipping,[12-14] debonding,[15-16] microleakage,[17] and even to a full fracture of the structure.[7,18,19] These characteristics are essential since these new materials have been developed to be mainly used in anterior crowns/veneer rehabilitations, such as a recent hybrid ceramic material, which consists of a lithium silicate enriched with zirconia (SiO_2 (56-64%), LiO_2 (15-21%) and ZrO_2 approx. 8-12% by weight). As it is an up-to-date reinforced lithium silicate ceramic, there is still lack of information and literature about its uses and implications. The present manuscript aims to describe a 2-year follow-up of a clinical experience with a zirconia-reinforced lithium silicate ceramic for anterior crowns.

CLINICAL REPORT

A 31-year-old female patient reported esthetic discomfort due to discoloration, buccal projection, degradation of maxillary anterior teeth composite resin restorations, and trauma caused by central incisors' endodontic treatment. In the first session, wear of direct composite resin restorations was identified as affecting both restorations' shape and color. The first treatment option would be orthodontics, for a palatal move/repositioning of referred teeth, however the periapical radiographic image suggested anquilosis, leading to the following options: (1) Ceramic veneers: with color limitations mimicking/alteration and palatal alignment. Reason for disregarding it: teeth would still be buccally projected as before with mandibular incisors not touching the

marginal ridges of the maxillary central incisors in a protrusive movement, and (2) Complete zirconia crowns layered by ceramic veneer and a ceramic veneer for the lateral incisor: a possibility of establishing esthetics, positioning, color and anterior guide. With buccally projected teeth, tooth preparation aiming to align the tooth in palatal direction would possibly diminish its height, as reduction at the buccal face would lead to incisal reduction. The patient signed consent form that included all treatment options and descriptions, explanations and doubts/questions answered by the clinician.

DIAGNOSTIC PROCEDURES AND WAX UP

In the first clinical session, occlusion and mandibular anterior teeth esthetic and functional conditions, anterior guidance, esthetic profile, and smile harmony were analyzed. Initial appearance is illustrated in Figures 1A and B and the periapical radiograph in C. Impressions with irreversible hydrocolloid were made for diagnostic casts and maxillary references check of median line. Diagnostic casts were then used for anatomic diagnostic wax up for the first mock-up. An initial silicone guide was used to preview the need for palatal incisors repositioning (dental tissue to be removed). An inclination guide was applied for esthetics and functions re-establishment.

Figure 1a

Figure 1b

Figure 1a-c: Intraoral pretreatment photograph showing incisor discoloration and degradation of composite resin restorations: (A) facial view and (B) incisal view; (C) initial periapical radiograph showing presence of endodontic treatment of central incisors. Note that it is also possible to notice buccal projection of left maxillary lateral incisor.

CLINICAL PROCEDURES

All older composite resin restorations were removed by using a spherical and cylindrical diamond bur. Maxillary-central incisor teeth were prepared in the second session with a 0.5 mm supragingival chamfer. Preparations were finished with burs and polished with diamond rubber tips. Provisional crowns were prepared using a cross-sectioned silicone mold previously made using the diagnostic wax up. After teeth preparation, acrylic resin was poured in the mold and applied onto the prepared teeth. In the third session, the provisional anterior teeth were removed and double-cord technique was applied, with the cord impregnated with a hemostatic solution *(Figure 2B)*. Definitive complete-arch, 2-phase impression was made with a combination of heavy- and light-viscosity poly (vinyl siloxane) material *(Figure 2B)*. Master impressions were obtained *(Figure 3A)* and the functional waxing *(Figure 3B)* was performed for the second morphology, proportions, and targeted teeth harmony analysis, serving as model for subsequent silicon guide impression and for mock-up. An impression of opposing dentition was also made with irreversible hydrocolloid. An occluding centric relation record and a face bow transfer were obtained with poly (vinyl siloxane) material. A1 shade was chosen for this patient. The mock-up and prosthetic prototype, could then be observed *(Figure 4A)*.

Figure 2a

Figure 2a-b: (A) Tooth preparation for ceramic crowns made using Suprinity Vita Ceramic; (B) Functional impression with poly (vinyl siloxane) impression material (addition-polymerized silicon) in 2 phases: (i) high viscosity and (ii) low viscosity. Note gingival retraction for moist control and to aid evidencing of cervical subgingival margins of preparation.

Figure 3a

Figure 3a-b: Facial view of definitive stone cast to be scanned: (A) showing preparations and (B) with functional waxing of crowns.

Figure 4a

CERAMIC RESTORATIONS

A novel zirconia-reinforced lithium silicate (Suprinity, Vita) was used in this clinical case report. A digital impression was made, chairside with the intraoral scanner of CEREC system and used as basis for the virtual design *(Figure 4B*). Using Biocopy software, new crowns were amended to restore the incisors' shape and conform to the existing teeth's shape, based on a "double scanning" technique. Biting edges and facial profiles were improved and the virtual cast positioning on the occlusal plane to obtain the median line (considering curves of Spee and Wilson). Insertion axis was then determined followed by die making process and the cervical tooth preparation margin delimitation and also the desired area for the virtual wax up for a crown suggestion. At the end of this process, it was possible to superpose the wax up image onto the definitive suggestion and to visualize the definitive crown in the selected zirconia block. With zirconia ceramic material ready for machining, crown copings were obtained and ceramic veneer was applied. Two different projects were made for the clinical treatment *(Figures 5A and B*), with different material fluorescence degree at the second treatment proposal *(Figure 5B*),

thus matching the first treatment proposal chosen by both patient and clinician. The use of crowns, manufactured with the new glass ceramic material was attempted. Milled lithium silicate crowns in the unfinished state may be observed in Figures 5A and B. The layer was made with VM.[11] Ceramic restorations were then glazed and fired. It is important to highlight that the left lateral incisor was in a palatal position relative to the spatial alignment of adjacent teeth generating a blackout shade and perception due to the incidence of low light on this tooth. For this purpose, a partial laminate was carried out to modify the buccal morphology, allowing a greater volume. There was no need for this tooth preparation , allowed a favorable insertion path for the laminated restoration. A VM[11] ceramic was used following the technique of 'refractory die'.

Figure 4a-b: (A) Anterior close-up showing morphological reproducibility of restorative mock-up technique made by bis-acrylic resin Structur 2 SC (VOCO GmbH), resulting into definitive prosthetic prototype; (B) anterior close-up of FIRST treatment proposal showing fluorescence of noncrystallized Suprinity infrastructures in accordance to virtual design of anterior crowns using CEREC system and Biocopy software.

Figure 5a

Figure 5a-b: (A) Anterior close-up of FIRST treatment proposal showing anterior view of milled Suprinity lithium silicate crowns in unfinished state. Note amber appearance in this phase (before being "sintered"); (B) Anterior close-up of SECOND treatment proposal showing milled Suprinity lithium silicate crowns in unfinished state. Note morphology, harmony and more esthetic perspective checked at "unsintered" phase and fluorescence of noncrystallized Suprinity infrastructures.

CEMENTATION AND FOLLOW-UP

Interproximal contacts were checked before cementation. Tooth surface was treated with 35% phosphoric acid before prophylaxis, followed by water cleansing. Ceramics were etched with 10% HF for 20 s and cemented with a resin-based luting cement, as recommended by the manufacturers. Figure 6A shows intercuspal evaluation for teeth's position and harmony panoramic view. An incisal view can be seen in Figure 6B. The same arch harmony can also be seen in Figure 7 after cementation with definitive result in Figure.[8] The patient received all postoperative care instructions and followed-up for 2 years *(Figure 9)*. In the first two months, the patient returned to the clinic every 30 days and currently every 6 months.

Figure 6a

Figure 6a-b: Anterior (A) and (B) incisal close-ups of treatment proposal chosen by both patient and clinician: definitive crowns (right maxillary central incisor and left maxillary central incisor) and a ceramic veneer (left maxillary lateral incisor) after cementation.

Figure 7a

Figure 7a-b: Post-cementation verifications: (A) Soft tissue healthy and (B) Fluorescence.

DISCUSSION

The second treatment alternative was chosen by the patient due to esthetics given by crowns and ceramic veneer, and the clinician agreed with the choice based on both the fluorescence aspects and mock-up. The objective for using the double scanning technique was to reproduce the definitive crowns as a definitive copy of the temporary crowns, based on the functional waxing with mock-up. Recent studies have shown that some ceramics exhibit lower strength but higher chip fracture resistance relative to porcelain-veneered zirconia.[12-14] The previous lithium disilicate-based ceramic has been shown to have the disadvantage of translucency degree variations, due to thickness and shade.[8] Advantages of lithium silicate material are translucency, fluorescence, and opalescence, lower milling time when compared to other ceramics, and possibility of use of any vacuum furnace that supports a slow cooling rate and no need for firing paste (placed directly onto a honeycombed firing tray). The most "tooth-like" definitive result seems to meet expectations for an anterior rehabilitation. Milling reflects high finishing capability, presenting a very smooth surface, probably related to its smaller particles composition. This new material can be conditioned with HF as zirconia is acid-resistant and HF attacks lithium silicate vitroceramic, making a selective surface dissolution, creating pores/gaps for silane action. Zirconia's role is reinforcement (flexural strength (3-point-bending test) is ≈ 420 MPa; elastic modulus ≈ 70 GPa and fracture toughness is ≈ 2.0 MPa.m-0.5, according to the manufacturer). A recent literature[20] confirmed that the zirconia reinforced lithium silicate glass-ceramic has higher mechanical properties than the lithium disilicate glass-ceramic: the fracture toughness was found to be 2.31 ± 0.17 MPa.m-0.5, the flexural strength was 443.63 ± 38.90 MPa, the elastic modulus was 70.44 ± 1.97 GPa, and the hardness was 6.53 ± 0.49 GPa. In the same study,[20] the lower machinability was confirmed as well as its higher brittleness index (2.84 ± 0.26 µm-1/2).

A low-melting, fine-structured feldspar veneering ceramic is a especially developed porcelain for individualizing restorations made with lithium silicate infrastructure. This ceramic has been deemed to provide a "natural play of colors" by the manufacturer and it could be verified in this treatment report at the end of treatment *(Figures 7 and 8)*. Initial edge quality and grinding and polishing properties evidenced in the present study could be noticed soon after cementation of the crowns and were the main reason for the patient's contentment as it provided ease of hygiene procedures and comfort of the inside lining of lips, owing to a smoothly sealed surface. The patient received all postoperative care and follow-up. In the first two months, the patient returned to the clinic every 30 days, and then every 6 months. The 2-year follow-up images can be seen in Figure 9.

Figure 8: Definitive result showing smile harmony and patient's satisfaction.

Figure 9: 2-years follow-up.

SUMMARY

The lithium silicate material used in this study appears to be a satisfactory alternative for anterior crowns rehabilitation, achieving both esthetic and functional aspects, however further investigation is necessary to evaluate its clinical longevity.

MANUFACTURERS' DETAILS

- Irreversible hydrocolloid: Elite Zermachalginate; Zhermack;
- Material for the silicone guide: Zetalabor; Zhermack;
- Diamond bur for removing the composite: #4138; KG Sorensen;
- Dental preparation burs: #3200/CN, #4205, #4209 burs; KG Sorensen;
- Finishing burs: : #3168FF, #4209FF and #4211FF; KG Sorensen;
- Polishing tips: Astropol; Ivoclar Vivadent;
- Acrylic resin: GC Pattern Resin; GC;
- Cords (double-cord technique): Ultrapack #000 and #00; Ultradent;
- Hemostatic solution: Hemodent; Premier Dental Products;
- Heavy- and light-viscosity poly (vinyl siloxane) material: Elite HD +Regular Body Set; Zhermack;
- Interocclusion registration: OBite; DMG;
- Color shade: Vitapan 3D-Master color guide; VITA;
- Ceramic: VITA Suprinity; VITA
- VM11: VITA;
- Luting cement: Variolink Veneer (Ivoclar Vivadent);

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