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Interest of Zirconia-Reinforced Lithium Silicate Ceramic (ZLS) on the Fabrication of a Partial Restoration in Posterior Teeth

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Abstract **Case Report**

Over the last two decades, a shift towards the indication of all-ceramic restorations has been sought the dentistry to meet higher esthetic demands. Having an ideal material that combines the indications of the others materials and limits their disadvantages, is the goal of the researchers who try to satisfy our needs. Recently, zirconia-reinforced lithium silicate glass ceramic was introduced in the market. Indeed, thanks to its interesting mechanical and optical properties, its fine and homogeneous microstructure, and its minimal wear of the opposing teeth after optimal polishing, this ceramic milled in monolithic restoration seems to outperform lithium disilicate and conventional zirconia crowns.
Keywords: Esthetic, endocrown, monolithic restoration, ZLS, Lithium disilicate glass ceramic.

INTRODUCTION

The increase of patient demand for natural looking restorations had led to the improvement of new materials and manufacturing technology. Thanks to their chemical stability, esthetics, and biocompatibility, which are preferable to those of conventional metal-ceramic restorations, ceramics ones were widely used and chosen from clinicians especially with the implementation of Computer-Aided Design/ Computer-Aided Manufacturing (CAD/CAM) [1].

However, due to the inherently brittle nature of ceramics, leading to fracture for glassy ones and cheeping for zirconia based crowns as well as the abrasive effect; their application in posterior teeth was compromised and seemed to be not optimal. To solve this problem and looking to reduce the dental office appointment and the presence of processing flaws to minimum, eliminating the veneered ceramics in favor of monolithic restorations was a revolution [2]. Zirconia-reinforced lithium silicate ceramic is one of the monolithic CAD-CAM materials developed to improve the optical and mechanical properties of restorations without requiring a veneering porcelain [1].

The present paper aims to briefly shed light on the different indications, advantages and shortcomings of this new material through a clinical case.

CASE REPORT

A 35-year-old female patient attended the prosthodontic department requiring prosthetic treatment of the upper right first molar (teeth # 16) with extensive coronal loss tissue after losing her previous restoration due to the loss of retention. The medical history was noncontributory.

At the first appointment, radiographic and clinical examinations were performed. The large defect was too important but still in supragingival level and a large pulp chamber with greater amount of residual enamel. The radiographic findings revealed well-sealed canals.

The patient had an acceptable oral hygiene and a favorable occlusion. She was looking for a natural restoration and rapid processing. The decision was to indicate all-ceramic endocrown fabricated from precrystallized zirconia-reinforced lithium silicate (ZLS).

At the beginning of the second clinical appointment, shade selection using a conventional shade guide was made. After removing all decayed tissue and due to the extensive damaged tissue, the ferrule design was preferred while the others guidelines for the endocrown's preparation were respected (Fig-1). After cleaning and polishing the preparation, impressions were taken with additional silicone and sent to the laboratory (Fig-2).

Fig-1: The preparation of the ferrule design and avoiding the pulpal floor

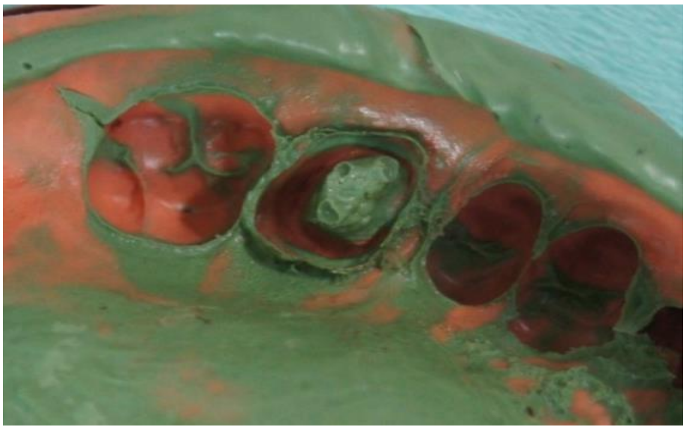

Fig-2: Maxillary impression using additional silicone

The conception was made; the restoration was milled as a full-contour monolithic partial crown from precrystallized ZLS blocks using CAD/CAM technology (Fig-3).

The restoration, partially crystallized, was placed in the patient's mouth and tried with a try-in gel to evaluate the interproximal contacts and marginal integrity (Fig 4 & 5).

A careful checking for occlusal contacts was possible and selective adjustment was done with a low-speed hand-piece and finished with a rubber cup at mild pressure. As the precrystallized stage of the material is easy to process, the contour and the occlusal surface should be worked out in as much detail as possible.

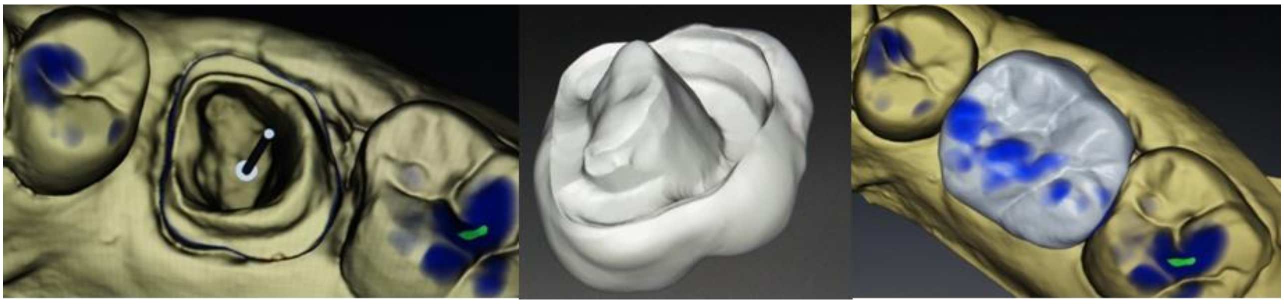

Fig-3: Construction of the monolithic virtual endocrown with Computer Aided design software

Fig-4: Fitting the restoration partially crystallized on patient's mouth to evaluate the marginal integrity and checking the occlusal and proximal contacts

Fig-5: A radiographic to validate to marginal integrity

The second sintering was performed according to the manufacturer's instructions to reach the material strength required and color modifications using pigments had led to the final characterized and glazed restoration that was checked for last time. ZLS ceramics must not be air-abraded with Al2O3 (Fig-6).

Prior to adhesive luting, the internal surface of restoration was conditioned with hydrofluoric acid 5% for 20 seconds, rinsed, dried then coated with a silane material.

While, after isolation and cleaning the cavity, the enamel was etched with 37% phosphoric acid for 30 seconds and exposed dentine for 15 seconds, rinsed, dried and adhesive was applied. Finally, a thin layer of a dual-curing resin cement was applied to the restoration followed by a polymerization and excess were removed.

One week after cementation, the patient was re-examined and reported no postoperative sensitivity. She was very satisfied with the treatment (Fig-7).

Fig-6: Restoration after being sintered and application of the glazing material

Fig-7: Definitive restoration one week after adhesive bonding, the good light-optical properties of ZLS allow a perfect color match

DISCUSSION

Over the last decade, zirconia and glass ceramics have known rapid advances and gained popularity in restorative dentistry in front of the increased aesthetics demands and biocompatible requirements [3]. Lithium disilicate ceramics (LS2C) is one of glass-ceramics, that was introduced in the 90s with the commercial formulation "IPS Empress 2" then in 2005 a new formulation was marketed as "IPS e.max Press" exhibiting improved mechanical properties and optical features, especially as regards translucency. Moreover, it is an acid-sensitive ceramics thanks to the presence of silica, so that high strength of adhesion to the substrate is expected [4]. However, its strength may be not optimal for posterior application. On the other side, zirconia, as a polycrystalline ceramic, has increased gradually owing to their superior fracture toughness and flexural strength compared to other dental ceramics. In several clinical studies, the most common technical complication of zirconia ceramics for framework have been observed with chipping of the veneering ceramic. Additionally, and differently from glass-ceramics, it is not susceptible ton acid etching techniques so it does not take advantage of adhesive bonding procedure [4, 5]. Recently, a zirconia-reinforced lithium silicate ceramic (ZLS) has been introduced to the dental market; it aims to combine the positive material characteristics of both lithium disilicate ceramic and zirconia [1]. This new glass ceramic milled by CAD/CAM technology, is enriched with particles of zirconium dioxide (≈ 10% by weight) embedded in the lithium silicate glass matrix [6].

There are two commercially available zirconia-reinforced lithium silicate glass ceramic. In common with IPS e.max® CAD, Vita Suprinity® (Vita Zahnfabrik) milled in a partially crystallized state and is subsequently heat treated to achieve full crystallization at 840°C which was the material used in the present clinical case and Celtra® Duo (Dentsply DeTrey) that in contrast to IPS e.max® CAD and Vita Suprinity®, is machined in a harder fully crystallized form which is suitable for the time-saving chairside applications [7-10].

Both are anatomically contoured as monolithic restoration due to enhanced translucency and different shades. In fact, the crystal size in the ZLS blocks are very fine that provides a higher percentage of glass content (roughly 50%) and such a microstructure demonstrate similar and higher mean translucency values compared to feldspathic and lithium disilicate blocks, respectively [1, 11-12]. Moreover, the inclusion of zirconia particles in the lithium silicate glass matrix has been reported to reinforce the ceramic structure by providing crack interruption [1, 13-15]

Undoubtedly, the use of such monolithic restorations where the lower fracture toughness porcelain veneer is eliminated, seems to meet the criteria of minimally invasive dentistry and preservation of healthy tooth structure [10, 16].

Thus, the flexural strength which is higher than lithium disilicate and can reach 450 MPa after glazing (approximately 100 MPa higher) [10] together with the high mean of translucency make the ZLS a proper choice for minimally invasive restorations, inlays, onlays, partial crowns (endocrowns), veneers, anterior and posterior crowns and anterior and posterior single tooth restorations on implant abutement; also fulfilling the “no prep”, table-top strategy [9, 10, 18].

Thanks to its ultrafine (0.5 um) granules that guarantee a homogeneous material structure, the polymerization shrinkage is avoided during the second sintering contrary to lithium disilicate glass ceramic where 15-20% contraction of the material may lead to a reduction in the density between the onlay and the tooth [19].

Additionally, even after extended artificial ageing, monolithic anterior crowns fabricated from zirconia-reinforced lithium silicate especially Celtra Duo kept a high fracture resistance which make it suitable for clinical use [20].

Edmara *et al*., in their study evaluating the effect of the thickness on survival and failure mode, demonstrated that caution is advised when intending to use ultra-thin restorations (< 0.5mm thickness). While 1.0 mm and 1.5mm crowns exhibited high reliability at clinically relevant molar loads [11]. Moreover, because a ceramic matrix is predominantly glass (from 8% to 12% zirconia), this material is considered acid sensitive and susceptible to hydrofluoric acid etching, unlike polycrystalline ceramics. As a result, the surface of the ceramic becomes rough, which is required for micromechanical retention. Nevertheless, acid concentration and duration of action must be strictly controlled.

The best surface treatment preparation was obtained with a 4.9% solution gel of HF applied at room temperature for 20s [13, 15]. Nevertheless, if any occlusal adjustment of this glass ceramic surface is required, it can lead to a minimal surface roughness and may have a more deleterious effect on the opposing dentition than significantly higher roughness resulting from prolonged intra-oral exposure. So that polishing is necessary to decrease subsequent initial surface wear [21].

Hence, the main disadvantage of this material would be the loss of repair potential and the mandatory need of crown replacement, which adds time and coast to both patients and professionals [11].

CONCLUSION

ZLS-ceramics offer a good combination of high strength and outstanding optical properties. To date, as regards the clinical performances, data are still limited, often controversial and short-term. Results from additional clinical studies both in vitro and in vivo are required to define physical-mechanical properties, clinical indications, limits and long-term performance of such restorations.

Conflict of Interests: The authors declare that there is no conflict of interests regarding the publication of this paper.

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