



## Partially-Veneered Zirconia Crowns for Maxillary Midline Diastema Closure

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### Abstract

**Background:** Maxillary midline diastema is a common esthetic problem that may affect patient's self-esteem. Many treatment modalities are available for diastema closure from surgery, orthodontics to composite build up, veneers and crowns. The choice depends on the extent of the diastema and the malposition's associated.

**Case Report:** A 28-year-old male patient presented with diastema in his upper front teeth associated with important malposition. A preoperative study performed on diagnostic casts led to the choice of partially veneered full coverage zirconia crowns to ensure achieving adequate teeth proportions and gingival levels.

**Conclusion:** The presence of maxillary midline diastema is a very common esthetic problem. Among a wide array of treatment options, full coverage zirconia crowns are a reliable treatment when remaining enamel is insufficient to indicate laminate veneers. Partially veneered zirconia crowns ensure high mechanical properties biocompatibility and color stability overtime.

**Keywords:** Partially-Veneered; Maxillary Midline

### Introduction

Zirconia (Y-TZP Yttria tetragonal zirconia polycrystal) is a polycrystalline ceramic material that was introduced in dentistry in the early 1990's to replace metal framework in fixed prosthetic rehabilitation [1]. According to Guess, *et al.* [2], zirconia has a flexural strength of 900-1200 MPa similar to metals such as steel [3]. In fact, metal ceramic restorations have always offered acceptable aesthetics and mechanical properties. However, the greyish appearance at the gingival margin, the difficulty of color mimetism because of the opacity of metal, in parallel with the evolution of ceramic materials [4] have encouraged the development of metal free dentistry.

Zirconia has been introduced as a core material layered by esthetic porcelain for more esthetic result. The zirconia framework provides mechanical resistance to the restoration since it is

qualified as the strongest and toughest of all dental ceramics [5]. Zirconia core will then be covered by veneering ceramics using a layering technique, a press technique or the two techniques at the same time.

However, a high rate of failure of this type of restorations was confirmed by several clinical reports and was due mostly to the chipping phenomenon [6-8].

According to Raigrodski, *et al.* [9], zirconia based fixed dental protheses presented more important rates of chipping compared to metal ceramic protheses.

Many factors causing chipping were studied by authors like the non uniform frame thickness under the veneering porcelain, occlusion factors and incoherence of coefficient of thermal expansion between the two materials [10-12].

Although zirconia single crowns placed on anterior segments showed higher success rates than posterior crowns the risk of chipping increases with a traumatic occlusal scheme such as a deep overbite [13].

Besides materials strength, other factors affect restorations 'clinical longevity, such as prosthesis design [14]. To avoid the chipping phenomenon, there has emerged a new type of restoration that consists on a full contour zirconia restoration without any porcelain layer on the palatal side in a conception that recalls the composite veneered metal crown.

In this work, we will describe an improved monolithic zirconia restoration that combines durability and acceptable esthetic result.

Case Report

A 28-year old healthy patient presented to the department of prosthodontics of the dental clinic of Monastir, Tunisia with an esthetic concern about an intransitive diastema associated with a lack of harmony in the positioning of his maxillary central incisors. Intraoral examination revealed a large intransitive diastema of about two millimetres. The two central incisors were asymmetrical with an important axial inclination of the tooth 11 both vertically and horizontally as shown on the figure 1 and Figure 2. Occlusal examination showed a deep bite. The central incisors were square-shaped.



Figure 1: Initial situation.



Figure 2: A right view.

Impressions were taken using Alginate (alginate; Alginmajor, Major) and then poured with type IV dental stone. On the diagnosis casts, a precise analysis was performed to decide whether to veneer or to crown the two teeth. We have begun by scraping the two teeth using a No.15 scalpel blade. This procedure allowed us to evaluate the quantity of sound dental tissue to be removed to simulate the correct shape, function, and esthetics (Figure 3 to 5). Effectively, above 2mm of sound tissue were removed which means that preparation exceeded the thickness of enamel.



Figure 3: A left view.



Figure 4: Occlusal View of the stone casts before scraping.



Figure 5: Occlusal view after scraping of the stone casts demonstrating an important amount of tissue to remove.

When we talk about ceramic veneers, bonding to the enamel is the key of success. The analysis performed on the cast showed that, in order to ameliorate shape and position of the two central incisors, more than 50% of dentine will be exposed which contra-indicated ceramic veneers.

The patient was interested in a durable esthetic restorations. So, after the pre-prosthetic analysis, a treatment plan including the application of full contour zirconia crowns modified by applying veneering ceramic only on the vestibular side in a concept simulating the classical metal crown with resin veneers.

After the patient signed the informed consent, diagnostic waxes were prepared. From the waxes, a silicone guide was made enabling us to realize the mock up. On the mock-up, the patient could correct any of his dissatisfactions (Figure 6).



**Figure 6:** Mock-up.

### Shade matching

It is highly recommended to choose the color of final restorations and dress up a color mapping on hydrated sound teeth before to undertake the preparations. In this case, we used A-D shade guide®, IVOCCLAR VIVADENT.

### Teeth preparation

The two maxillary central incisors were prepared to receive a modified full contour zirconia crown using round diamond bur (#6856 - 014). It required a round shoulder preparations for labial, lingual, mesial and distal margins. All corners and sharp edges should be rounded. The taper should be 5 to 15 degree. It was crucial during this phase to use the silicone guide, obtained from the wax-up, to guide the quantity of reduction in tooth preparation.

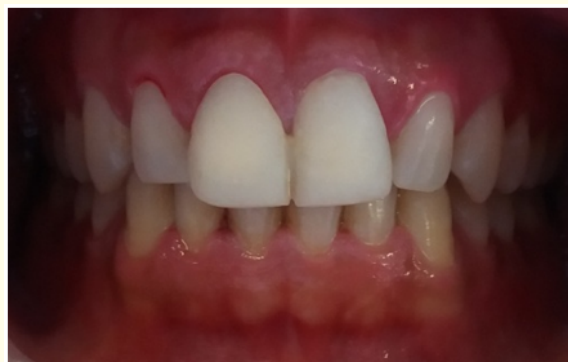
The preparations were finally finished using multilayered carbide burs and polishing discs (Figure 7).



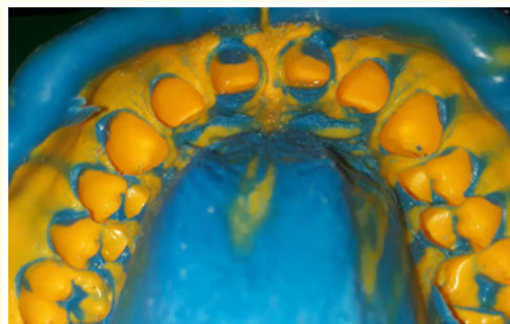
**Figure 7:** Preparations.

### Provisional restorations and impression procedure

A simultaneous double-mixed impression was made with heavy and light viscosities of addition silicone (IVOCCLAR VIVADENT, Schaan, Liechtenstein) after a double gingival cord retractant (Figure 8 and 9).



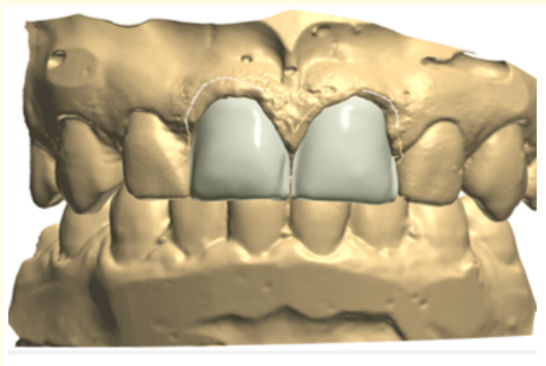
**Figure 8:** Provisional restorations.



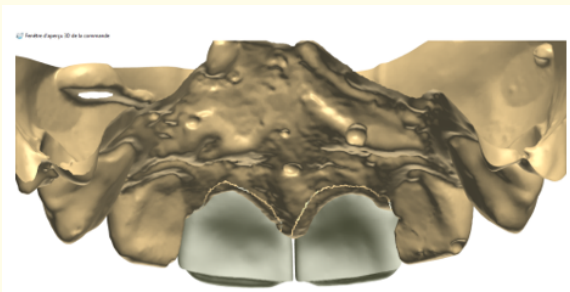
**Figure 9:** Simultaneous double-mixed impression.

### CAD/CAM

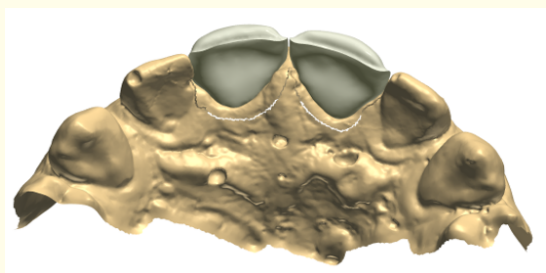
Frameworks of the all ceramic crowns were fabricated using Y-TZP ceramic manufactured by CAD-CAM system (Figure 10 to 12).



**Figure 10:** Buccal aspect (Computer assisted design) providing adequate room for veneering.



**Figure 11:** Palatal aspect (Computer Assisted Design).



**Figure 12:** Incisal aspect (Computer assisted design).

### Trying session of the two zirconia crowns

In a first clinical session, the zirconia crowns with vestibular recessed face (AMMAN GIRRBACH®, Zirconia Disc, IVOCCLAR VIVADENT) was tried in and internal fit and marginal adaptation were assessed in the prepared tooth (Figure 13). Occlusal contacts at the maximum intercuspitation and mandibular movements were adjusted at this stage. The verification of zirconia thickness of the framework is paramount. (Figure 14).



**Figure 13:** Trying session of zirconia cores.



**Figure 14:** Verification of adequate thickness of zirconia in the palatal side.

Then, the veneered crowns are also tried in (Figure 15).

Finally, the modified zirconia-based crowns were cemented using glass ionomer cement (FUJII GC®, GC CORPORATION TOKYO JAPAN) since it has a polycrystalline structure with no glass phase (Figure 16 to 19) and the patient was satisfied with the final result.





**Figure 15:** Trying session of the veneered crowns.



**Figure 16:** The modified full contour zirconia crowns.



**Figure 17:** Final aspect of the restorations after cementation.



**Figure 18:** The palatal view showing the white opaque aspect of zirconia.



**Figure 19:** The final smile.

## Discussion

Interincisive diastema is nowadays a frequent reason for consultation. In a review realized by Parrini, *et al.* in 2016 [15], a diastema of more than 2mm is considered as an unfavourable smile characteristic in the majority of reviewed studies.

Orthodontic treatment is considered as the treatment of choice [16]. However, many difficulties are related to this option like the high financial cost, the long-span treatment and the complicated hygiene procedures. Sometimes orthodontic treatment is insufficient and complementary restorative procedures are necessary when diastema is associated with malformation, dental misalignment and disharmony [17].

Proximal build ups with resin composite are considered as practical and conservative. However, when an important malposition exists, they give unesthetic result, in addition to the color modification over time.

Porcelain veneers are considered as an interesting option. But, their durability is depending on many factors [18,19]. Morimoto, *et al.* [20], have indicated that the survival of ceramic veneers is rarely 100%, and during preparation procedure, a due care is given to keep the preparation within the enamel. Besides, traumatic occlusal scheme should be avoided [21].

In a study realised by Gurel, *et al.* [22] A survival rate of 99% was observed for veneers with preparations confined to enamel and 94% for veneers with enamel only at the margins. Laminate veneers have high survival rates when bonded to enamel and provide a safe and predictable treatment option that preserves tooth structure.

So, preoperative studies on the dental casts is important to assess the amount of enamel to be removed. In fact, according to Umehara, *et al.* [23], enamel thickness on the maxillary central

incisors were of 0.9 mm on the central third, more important on the incisal third with 1.1 mm and thinner on the cervical third with 0.5mm. When, more than 50% of enamel is removed, full coverage crowns are the best option to choose.

Zirconia has been introduced in dentistry in the 1960s. Thanks to its interesting mechanical properties, zirconia has always been chosen as a reliable framework material. Then it is covered by feldspathic porcelain because of its lack of translucency and to achieve a more esthetic outcome.

However, it has been reported in various studies that the most common complication of zirconia ceramic restorations is the chipping of cosmetic ceramic. Raigrodski, *et al.* [2,9] have even reported higher chipping rates than metal ceramic restorations. Also Guess, *et al.* [2] affirmed in their study that none of the zirconia core and veneering ceramics could attain the high bond strength values of the metal ceramic combination.

Many causes were incriminated when studying the chipping's phenomenon by authors such as:

- The insufficient mechanical resistance of feldspathic ceramic
- Inappropriate design of the zirconia core.
- The difference of the coefficient of thermal expansion between the two materials [9].
- The difference of modulus of elasticity between the two materials [24].
- Insufficient cooling during the veneering process [25].
- The low thermal diffusivity of zirconia compared with that of alumina or metal [26].

So, in order to avoid the chipping phenomenon, a trend of full-contour-zirconia restorations has emerged. This type of restorations consists on eliminating the porcelain overlay and Manufacturers have been striving for a more translucent monolithic zirconia restorative material to fulfil the extremely high demand of the market [27].

In fact, in order to resolve the problem of high opacity of zirconia, some modifications were suggested like sintering temperature, addition of colouring liquids and the modification of the fabrication process. But, the problem here is that these modifications may affect the mechanical properties of zirconia [28-30]. Many authors studied the possibilities of modified Core design

increasing the support of the porcelain in the vestibular or lingual cusp which could improve fatigue response [31].

In the anterior zone, heavy functional loading observed in situations like edge to edge and cross bite occlusal relationship exposes veneered zirconia crowns to important risk of fracture. Also, a deep bite scheme create a tensile stress that may lead to half moon fracture. So, modified full contour zirconia crown with eliminating veneering porcelain on the palatal side help to avoid this type of complication.

Usually, tooth preparation for zirconia ceramic crown restorations with conventional YTZP frameworks requires a considerable amount of tooth reduction compared to porcelain fused to metal.

Because of the amount of tooth reduction, there are some difficulties in using zirconia-ceramic crown restorations in cases of vital teeth. However, a light chamfer can be prepared from the proximal to palatal side and the amount of occlusal reduction can be reduced when using modified contour zirconia crown [15]. This would allow less reduction for tooth preparation and help to preserve the tooth structure without damaging the remaining pulp in vital teeth, which is preferable in terms of the minimal intervention concept. These results would expand the clinical application of this type of restorations especially in young patients who have relatively large pulp cavities [32].

## Conclusion

The presence of maxillary midline diastema is a common esthetic complaint leading patients to seek for a solution.

A multitude of treatment modalities are available for the practitioners. The extent of the diastema possibly associated with misalignment are important criteria of success.

Diagnostic casts and precise preoperative study are of decisive importance.

Full coverage zirconia crowns are a suitable solution for some cases ensuring mechanical resistance, color stability and biocompatibility.

The concept of partially veneered crowns is an innovative approach that minimize tooth mutilation and then the risk of devitalization especially for young patients, in addition to decreasing the risk of chipping phenomenon observed with fully layered zirconia crowns.

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