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EVALUATION OF MARGINAL ADAPTATION OF (CAD/CAM) LAVA PLUS HIGH TRANSLUCENT ZIRCONIA AND (CAD/CAM) IPS-EMAX FULL CROWNS

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Abstract

The purpose of this research to compare the internal and marginal fit of two full crown's materials made by (CAD/CAM) machine "lava plus high translucent zirconia and Ips-Emax using replica technique.

The research sample consisted of 60 premolars prepared to have a full crown and it was divided into two equal groups (n1=n2=30), in the first group the full crowns were fabricated by Lava Plus high translucent zirconia whereas in the second group the full crowns were fabricated by IPS-Emax.

Marginal adaptation of the crowns was measured by (cement replica technique) before applying the cementation steps of crowns, gingivo-incisal sections and mesio-distal sections were made and measured the marginal adaptation in 3 points in the cervical area and 3 points in the contact area using the BX41 OLYMPUS optical microscope magnifying ×10. Normal distribution of data was confirmed by using Kolmogorov-Smirnov test, then data analysis was done using Independent samples t-test at significance level of (α=0.05).

The average marginal gap of the Lava Plus and IPS-Emax full crowns were 105.72 and 152.57 micron respectively, therefor there is a statistically significant difference at 95% confidence level ($p<0.05$), the average marginal gap value of the second group was higher than the first group by (46.85 micron).

Among the limitations of this study we conclude that the marginal gap value of the full crowns varies according to the material which they were fabricated by it, Thus, LAVA Pluas high translucent zirconia Full crowns have more adaptation than Ips-Emax Full crowns as it represents less marginal gap values, although all values were within clinically acceptable limits.

Keywords: *marginal adaptation, Lava Plus, High translucent Zirconia, CAD/CAM, IPS-Emax.*

Introduction

The presence of a defect in the upper front teeth greatly affects the cosmetic aspect, which can be treated with several prosthetic options such as full-porcelain crowns and porcelain laminate veneers, where the option of treatment with full-porcelain crowns was the first option for several years ago. But sometimes it is considered a non-conservative method because it requires the removal of large amounts of dental tissue to meet the standards required for some ceramic materials [*Peumans M et al., 2004; Da Cunha L et al., 2014*]. For several years ago, feldspar porcelain was considered one of the best materials that provide high aesthetic results, but its weak resistance makes it a brittle material, so the trend was towards materials that provide high aesthetic properties in addition to high flexural strength and resistance [*Garber D, 1993; Griggs J, 2007*].

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After that, many studies were conducted to develop feldspar ceramics, which led to the emergence of new types of advanced ceramics. It became common to use glass ceramics containing lithium disilicate crystals (IPS: E-max) in making full ceramic crowns and porcelain laminate veneers due to its properties Excellent cosmetic properties and resistance to bending and breaking, and this material is commonly used in the form of compresses according to the method of heat-pressed ceramics [*Miyazaki T et al., 2009*]. Recently, the cosmetic requirements of patients visiting dentists have increased, and the materials that achieve these requirements and help the dentist to provide appropriate treatment and the main goal that patients seek in this way have also increased, as well as the emergence of new cosmetic ceramic materials such as translucent zirconia. Lava Plus, which achieves the principle of preserving dental tissues. It is considered a minimally prepared material and gives very high cosmetic results in addition to mechanical properties such as resistance to bending and fracture resistance in a very high degree, similar to traditional zirconia, as it is cemented using dual-cure resin cement or light cure [*Sadowsky S, 2019*] after sandblasting and application of special agent such as saline containing MDP [*Stawarczyk B et al., 2017*].

High -translucent zirconia is one of the very modern materials in the field of dentistry, where the first generation appeared and then was developed to reach the third generation, which is a high translucent and resistant to fracture and gives excellent cosmetic results and provides a lot of dental tissue [*Luthardt R, 2004; Al-Samara S, 2020*]. Recently, the method of computer design and manufacturing (CAD/CAM) has been entered into clinical practice in dentistry, where crowns and porcelain laminate veneers are manufactured using this technology that reduces complex laboratory procedures, and thus reduces time and cost, and the doctor can give the patient a model of the shape of the final smile is done via the computer after the smile is designed, and therefore many modifications can be made to it, which gives the doctor confidence in the patient and the dentist avoids potential problems, including the patient's dissatisfaction with the final shape of his smile [*Tinschert J et al., 2004; Li R et al., 2007; Pereria D et al., 2018*]. The clinical performance of porcelain crowns depends on several factors, the most important of which are the marginal and internal adaptation of these crowns, as incomplete adaptation of the porcelain crown can lead to oral fluid leakage, cement dissolution, crown discoloration and secondary caries, and can also cause disengagement of the crown and thus failure Many studies have studied the clinical evaluation of full-ceramic crowns made of zirconia by computerized design method (CAD-CAM), but the information was limited about full-ceramic crowns made of high translucent zirconia by computerized design method, so the aim of this research is to clinical evaluation For full-ceramic zirconia crowns made of CAD/CAM according to the standards of the International Dental Federation, in addition to the study of the marginal and internal adaptation of these crowns before they are cemented [*Karagözoğlu İ et al., 2016; Pereira DD et al., 2018*].

Materials and methods

The research sample consist of 60 complete ceramic crowns divided into two groups: The first set: consists of 30 full ceramic crowns from 3M (lava plus zirconia) Translucent-zirconia, manufactured by CAD/CAM method. The second group: consists of 30 IPS E-max ceramic crowns manufactured by CAD / CAM method.

The work stages began with examining the patient and asking about chief compliment and realizing the expected cosmetic requirement of the treatment with asking the patient about general diseases, filling out the patient's form and talking oral pictures (Fig. 1a) with a picture of the state of the smile (Fig. 1b).

An impression was taken using condensation silicone with the Putty wash technique and has been cut off to create a preparation guide and to strip the required thicknesses, in addition to using depth determine burs to adjust preparation thicknesses or to make guide joints in the first preparation steps.

After that, the teeth are prepared

To overcome it is possible, due to the uniting the knowledge and will of all doctors in the world

Figure 1. (a) *Oral picture of the patient and* ***(b)*** *the state of the smile*

to receive ceramic crowns, where the first premolars were prepared to receive the ceramic crowns from Lava Plus by reducing the occlusal surface by 0.6-1 mm according to the indications, and then the second premolars were prepared to receive ceramic crowns from IPS E-max by reducing the occlusal surface by 2-1.5 According to the indication, the buccal surface was prepared, starting with a depth determination bur to adjust the preparation depth, and then removing the enamel material between them by the conical bur, then prepared the other axial and interproximal surfaces (Fig. 2).

Then the procedures for taking the impression began, where first the appropriate trays were chosen for the patient, and then the impression was taken by the hard and soft silicone of the type (Aditional Silicone – polly viniyl siloxan), and a wax bite for the prepared teeth (Fig. 3).

This is followed by choosing the appropriate color by means of a color guide, agreeing with the patient on the color and registering it, then we made the provisional with intra-oral acryl.

After that, the impression was sent to the laboratory with information about the color, age of the patient, and notes to make the design (Fig. 4).

After the ceramic crowns were returned from the laboratory, we began to remove the temporary prosthesis and cleaned the surface of the teeth until the entire temporary prosthesis was removed, and then we tried them in the patient's mouth to ensure that they descend and fit well and made sure of the cosmetic aspects of the faces while taking the patient's opinion and consent to the procedure of the cementation.

The study of marginal and internal fit

Before the ceramic crowns was cemented, we measured the marginal and internal fit of the ceramic crowns made of Lava Plus and performed on the first upper premolars, and the ceramic crowns made of IPS E-max and performed on the second

Figure 2. *Prepared premolars*

Figure 3. *The impression*

Figure 4. *The teeth design*

upper premolars, by the replica cement technique, started with We started with injecting the additional silicone on the inner surface of the crown.

And then the crowns were placed back on its abutment with the application of finger pressure until the soft silicone has hardened (Fig. 5).

After that we injected additional soft silicone of contrasting color, where the rubber was injected using manual shaking to ensure that the soft silicone reaches the finest details.

After the soft silicone hardened, and the crowns were removed. Thus, we obtained the silicone backing in two contrasting colors, as the thin layer is required to measure its thickness (Fig. 6).

After that, we used a surgical scalpel with a blade to make a mesial-distal, and gingival-incisal for each identical copy, noting that the cutting area is in the middle as much as possible and that the cutting line is flat and not serrated.

Results

The research sample consist of 60 complete ceramic crowns divided into two groups:

The first group consists of 30 full ceramic crowns from 3M (lava plus zirconia) Translucent-zirconia, manufactured by CAD/CAM method.

Figure 5. *The crowns and the silicone inside them*

Figure 6. *Rubber abutment of two contrasting color soft silicone*

The second group consists of 30 IPS E-max ceramic crowns manufactured by CAD/CAM method.

The average of marginal gab of Lava Plus crowns in cervical area was (106.33) micron and (154.37) micron for IPS-Emax Crowns and the average of marginal gab of Lava Plus crowns in interproximal area was (105.11) micron and (150.77) for IPS-Emax crowns.

The average of all marginal gab was (105.72) micron of the Lava Plus full crowns and (152.57) micron of IPS-Emax full crowns (Table 1).

T-test-Student was used to study the effect of the material difference between the Crowns (Lava Plus and IPS-Emax) on marginal gab.

The average of marginal gab in cervical area of IPS-Emax Crowns was bigger than Lava Plus Crowns by (48.04) micron, and the average of marginal gab in interproximal area of IPS-Emax Crowns was bigger than Lava Plus Crowns by (50.66) micron, and all marginal gab of IPS-Emax Crowns was bigger than Lava Plus Crowns by (46.85) micron (Table 2).

The above table shows that the value of the significance level, ($p<0.05$) much smaller than the value 0.05

That is, at the 95% confidence level, there are differences Statistical function between the two groups, and therefore The marginal gap value varies (in cervical area, in the interproximal area, as a whole) in the difference of manufactured material (Lava Plus – Ips-Emax).

Discussion

IPS-Emax is one of the most common and pop-

Table 1:

The average of marginal gab

	Material	Sample size	The average	SD
Marginal gab in cervical area	IPS e.max CAD	30	154.37	18.30
	Lava Plus	30	106.33	15.04
Marginal gab in interproximal area	IPS e.max CAD	30	150.77	18.36
	Lava Plus	30	105.11	13.30
All marginal gab	IPS e.max CAD	30	152.57	17.03
	Lava Plus	30	105.72	13.98

TABLE 2 :

The difference of two marginal gab

Variable	T Value	P Value	Diffrence	Field of 95% confidence	
				Lowest limit	Highest limit
The average of marginal gab in cervical area	16.059	0.000	48.04	40.79	49.55
The average of marginal gab in inter-proximal area	14.736	0.000	50.66	46.66	54.99
All marginal gab	17.353	0.000	46.85	40.09	51.52

for teeth that have cosmetic requirements because they achieve cosmetic aspects and acceptable mechanical and physical properties [*Beschnidt S, 1999; Calamia J, 2007; Gurel G et al., 2012*].

But with the development of the generations of zirconia, it led to the emergence of new materials that achieve cosmetic aspects completely similar to IPS-Emax and surpass them in terms of physical and mechanical properties in terms of flexural strength, shear and tensile forces [*Chen Y, 2007; Ludovichetti F et al., 2018*].

The marginal fitting of the crowns was evaluated using the Replica technique, which is an accurate, reliable and non-invasive method and expresses the applicability of the prostheses in general, whether they are crowns or veneers [*Birnbaum N, 2009; Al-Samara S, 2020*].

Three points of marginal fit were measured in the cervical areas and 3 of them in the interproximal areas, which are similar to the points used by Yuce M. and co-authors (2017).

The average marginal gap for Lava Plus crowns was (105.72) microns, while the average for IPS-Emax crowns was (152.57). This difference may be due to the fact that Lava crowns require less preparation and therefore less thickness, which reduces the deformations occurring in the material as well as the size of (CAD) burs used in IPS-Emax crowns are much larger than Lava crowns, and also Lava crowns are considered to be one monolithic while IPS-Emax needs multi layers to cover it.

Most of the researchers agreed that the acceptable values for the marginal gap are between (100-120) microns to avoid wear and loosening of the cement.

We agreed in this with Al-Dwairi Z.N. and colleagues (2019).

CONCLUSION

Among the limitations of this study we conclude that the marginal gap value of the full crowns varies according to the material with which it was fabricated by it, Thus, LAVA Plus high translucent zirconia Full crowns have more adaptation than Ips-Emax Full crowns as it represents less marginal gap values, although all values were within clinically acceptable limits.

RECOMMENDATIONS

We recommend to use Lava Plus High translucent zirconia as crowns in anterior teeth.

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