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The Ceramic Veneers: Comparative Clinical Study of the Different Types of Coronary Preparations

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Abstract

Introduction: The purpose of this investigation is to evaluate the influence of the design of the preparation on the longevity of porcelain veneers that are today widely used in the treatment of unsightly anterior teeth.

To do this, we've compared three different designs:

- The Type I: Window preparation leaving an intact incisal edge;
- The Type II: Incisal edge overlap preparation;
- The Type III: Palatal overlap preparation «full veneers».

In order to provide a reliable treatment for saving the future of the tooth.

Materials and Methods: Our study is a randomized clinical trial; on the comparison of 264 veneers stuck on 73 patients. The patient's recruitment was done according to well-defined inclusion criteria. The information was reported on a clinical record. The study lasted 64 months with regular checks of 6 months, 12 months, 18 months, 24 months, 36 months, 48 months and 60 months.

Results: In this study, the maxillary teeth prepared according to the three methods have shown that ceramic veneers have stable esthetic qualities; they are biologically acceptable in so far as the recommendations of current preparations are respected. The Chi square test revealed that there is statistically no significant difference between the three methods.

Conclusion: The Palatine return is not routine in preparation for ceramic veneers.

Keywords: Joint prosthesis; Veneers; Ceramic; Bonded restorations; Cosmetic dentistry; Adhesive dentistry; Tissue economy

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Introduction

We owe to Charles Pincus cited by Launois [1], the existence of ceramic veneers. He improved the smile of Hollywood comedians by temporarily fixing, during the filming; vestibular veneers in ceramic fired on platinum sheet [2] and fixed with an adhesive for total prosthesis will then be removed at the end of the shoot. But this technique was expensive and temporary, it was quickly abandoned. It resurfaces thanks to several factors:

- The development of etching of enamel by Buonocore in 1955 [3].
- In 1975, Faunce used prefabricated methacrylic resin veneers which were disappointing due to their poor adhesion to the bonding composite in addition to an over-contour following their assembly on unprepared teeth.
- The introduction in 1980 by Horn, the concept of chemical treatment of ceramic with Hydrofluoric Acid (HF) which was used in industry to etch glass; could also etch the ceramic. The bonding strength obtained between the etched ceramic and the resin was sufficient to ensure the retention of ceramic restorations including porcelain veneers [4].
- Horn and Calamia propose replacing the composite resin with etched and then silanized ceramic; and stick it to teeth the enamel has been prepared [5]. These American authors were the pioneers of this technique even if they took up the idea of Rochette who in 1975, used restorations

glued on fractured incisors.

- Codification by Gregg, a laboratory prosthetics, of the laboratory production of ceramic veneers on a platinum matrix.

In parallel with the evolution of ceramic materials and bonding materials, the protocol for producing ceramic veneers has also evolved. The form of tooth preparation has constantly changed to meet the challenges and failures that arise each time. At first, the prefabricated resin veneers were bonded to unprepared teeth, then bonded veneers produced by the direct method using micro-charged composite were assembled to the teeth whose surface was simply roughened by the rapid passage of a diamond rotary instrument.

From 1984, with the use of etched and silane feldspathic ceramics, developed first on platinum sheet, then on refractory lining, the preparations gradually became more important but generally respected the incisal edge except when the latter was fractured or required a lengthening. After; for aesthetic reasons, some practitioners have modified the preparations to include the incisal edges. And since the lingual return has quickly become a subject of controversy: For some authors this return is a classic characteristic of the preparation regardless of the ceramic used and whatever the clinical situation, while others claim the opposite [6].

Several types of preparations are described by Hui, then Clyde and Gilmour present three: A window or frame preparation, where an incisal limit of 1 mm is preserved, a preparation with an incisal bevel of 0.5 mm to 1 mm, and a preparation with return palatine in order to increase the translucency of the veneer ,Weinberg offers a 1 mm incisal reduction, with rounded angles and edges, while Sheet and Taniguchi describe a preparation with a pronounced palatine leave and a rounded limit for a thickness of ceramic appropriate. Castelnuovo recommend a preparation incorporating the incisal edge, to increase the resistance to fracture of the veneer and allow correct insertion [7].

From these different preparation proposals, 3 main types of preparations were chosen:

- Preparation of the contact lens type window (limited to the vestibular surface of the tooth without palatal return)

- Preparation with slight covering of the incisal edge;

- The preparation with a large incisal covering called semi-jacket.

To these three main forms of preparation a fourth has been added. It is represented by the window preparation modified by Touati: The preparation of the bevelled incisal edge (extended to the incisal margin but without the finishing line). Currently; the design of the preparation continues to be one of the most controversial aspects of this restoration. *In vitro* studies have been carried out by several authors, but clinical studies carried out for this purpose are very rare with often divergent results.

All these elements led us to try to find out more by doing a comparative study between the different types of preparation: Is the palatal return necessary? Is it not enough to limits yourself to the vestibular side? Would the ceramic veneer it's self constitute a reliable solution; sustainable and would it bring satisfaction to our patients? Through this study we will try to see the impact that different forms of preparations can have on the longevity of ceramic veneers.

The different forms of coronary preparations

Ceramic veneers without preparation: In 1975 Faunce cited by Touati et al. [8] introduced industrial laminated veneers "Mastiq" from Caulk. Although encouraging in principle, the results were quite disappointing in terms of marginal adaptation, emergence profile, and outline in general.

These conservative ceramic veneers with an average thickness of 0.30 mm are easily achievable and attract patients.

Ceramic film veneers: In window: They are partial vestibular crowns [9,10]. They are called apposition (veneer is not covering the incisal edge) or "in window" [11].

Such a design does not require an undercut [12]; the insertion of the veneers is not necessarily done in the axial direction of the support tooth; tissue reduction is homothetic. This preparation is strictly enamel.

Very thin from 0.30 mm to 0.60 mm only concerns the vestibular side of the tooth without palatal return.

Dental preparation: The reduction most often concerns only the vestibular enamel not exceeding 0.30 mm to 0.60 mm thick.

- It remains at a distance from the marginal gum [13,14].

- A homothetic preparation of the vestibular surface limited proximally by a fine border of enamel, without crossing the proximal contacts.

- The cervical border is a fine leave as close as possible to the gum to visualize the normal emergence of the veneer and avoid any over-contour.

- The veneer being placed vestibular; it is not necessary to perform an axial draft.

- The preparation ends with a very fine leave at the free edge, without encroaching on it. The actual thickness of a ceramic veneer is 0.40 mm to 0.70 mm [15,16], which comes very close to the thickness of natural enamel.

The modified film preparation embedded without lingual return: It is a very reliable preparation especially for canines and premolars [17]. It is called a built-in window and is intended for cusp teeth. The preparation and its limits are located entirely in the vestibular side.

It requires a reduction between 0.50 mm and 0.80 mm. It can be located at the dentine level. The cervical border will be a leave. At the free edge, the reduction is stopped, leaving an enamel border of a few tenths of a millimeter.

Ceramic veneers with slight palatal return: Called overlap veneers; because the incisal edge is included in the preparation [3]. Light recovery is the most frequent case [18,19]. The reduction of the free edge is around 0.60 mm to 0.80 mm for teeth with discoloration.

The contact points are preserved. The proximal parts of the free edge of the tooth must be included; the connection of the restoration must be made at the palatal side of the tooth. The posterior limit of the facet stops before the palatal concavity and ensures crimping of the free edge of the preparation. The solidity of the facet is thus reinforced by this effect of "strapping" [20]. This point of contact with the palatal side must not interfere with the enamel/ceramic boundary during occlusion. This limit must be below or beyond this point of contact.

Ceramic veneer in semi or half jacket: This preparation is very close to that recommended for ceramic-aluminous jackets [18,19]. The reconstruction of the incisal half or third of this type of restoration is similar to that of a corono-peripheral cap.

- The preparation is done on a thickness of 0.80 mm.
- The cervical limits at the proximal and lingual level are marked leaves.
- The proximal contacts are generally crossed and the proximal faces are parallelized [17].

Due to the general form of the preparation, retention is based on a concept close to that of the sealed prosthesis: It is obtained mainly by the form of the preparation and reinforced by the adhesion of dentin (Figure 1). From left to right preparation in semi-jacket; preparation in slight return; preparation without palatal return.

Problematical

As reported in the literature, the survival rate for ceramic veneers ranges from 18 months to 15 years [16]. But failures are also often encountered and generally result from detachments, infiltrations, cracks and fractures. Of all the elements that can be at the origin of these failures (mechanical quality of the ceramic used, the importance of the proximal returns, the surface of the tooth, the thickness of the ceramic, the type of bonding material, the tooth morphology, activities functional and para-functional) [21]; the overlap or not of the incisal edge is the most incriminated and controversial factor.

There is no consensus among the authors regarding the incisal edge when preparing a ceramic veneer [7,22-24].

For some, the incisal covering is necessary in all cases, in order to improve the mechanical resistance of the veneers, even if this implies the removal of 0.50 mm to 2 mm from an intact incisal edge or placing the margin in a vulnerable surface where there is contact of opposite teeth. For others, the incisal edge should not be incorporated into the preparation, unless aesthetic or occlusal requirements allow it.

Prospective studies and clinical trials have been carried out by several authors, with the aim of identifying the preparation which gives better resistance to ceramic veneers. *In vitro* studies have been carried out using two approaches: Either by using extracted human teeth or by prototypes of manufactured teeth. They remain limited because they do not quite reproduce the clinical environment: The chewing forces, the thermal variations and especially the behavior of the patient himself.

Some authors have even developed a computer-controlled mastication simulator that will expose the ceramic to 1.2 million cycles, which corresponds to a 5-year *in vivo* mastication simulation [25], because chewing is a factor that can play a very important role in relation to the survival of veneers. Unfortunately, there are few clinical studies examining the design of preparations for ceramic veneers and reports on the relationship between the design of the preparation and clinical longevity are rare [26].

In the Dumfahrt and schaffer study protocol, 72% of the veneers had an incisal edge overlap, which seems to guarantee reliability in view of the results (4% failure only). However, Hui show that the resistance of a tooth bearing a veneer decreases if there is an overlap of the incisal edge whereas it is equal to that of a healthy tooth in the absence of a covering. Similarly Hahn cited by Brunton obtained comparable results in an *in vitro* study, involving 36 teeth, where the fracture rate is less significant when only the vestibular surface has been prepared [27]. In an *in vitro* study, Highton reported a better distribution of the incisal load and, consequently, a lower stress concentration by including the incisal edge in the veneer restoration compared to a restoration without incisal overlap [28].

For other studies, the preparation without incisal covering allows the realization of a restorative force which is comparable to that of unprepared teeth and a resistance to structural rupture similar to that of unrestored teeth. What has been confirmed by Hui and Gilde who have shown that the covering design will transmit maximum stress on the veneer and increase the risk of cohesive fracture?

A fully prepared enamel-free incisor design withstood axial stress more favorably in this investigation. They concluded that, when strength is an important condition, the most conservative type of veneer, preparation without incisal overlay, was the design of choice. While in a clinical study by Meijering no correlation was found between the survival rate and different designs of incisor preparation after 2.5 years [29]. With regard to fracture resistance, these authors reported that none of the incisor preparation techniques had demonstrated any convincing advantage. What has been confirmed by Wall, who compared the fracture strengths of bonded ceramic veneers linked to reduced incisors of 0.50 mm, 1.00 mm and 2.00 mm, finding no significant difference between the different reductions in the incisal edge?

Therefore, the authors' opinions are divided between "no significant differences" and "presence of significant differences" between the different types of preparations with and without incisal overlaps. The combination of different materials and complex geometries makes it very difficult to analyze the distribution of stresses in the teeth [7]. Most of the clinical studies studied on the different types of veneers do not take into account the influence of the design of the preparation. All these elements led us to do this clinical trial to try to see if the shape of the preparations plays a role in the longevity of ceramic veneers.

Objectives of the study

Primary objective: Evaluate the effectiveness and durability of bonded ceramic veneers based on the coronary preparations made. To do this, we will compare three types of coronary preparations for bonded ceramic veneers:

Type 1: preparation without covering the incisal edge:

Contact lens type;

Dental enamel is reduced from 4 mm to 6/10 mm;

The preparation does not exceed the contact points on the proximal veneer and ends with a very fine leave at the free edge without encroaching on it.

Type 2: Preparation with light covering of the incisal edge:

Classic preparation type;

The reduction in enamel is greater from 6 mm to 8/10 mm;

The free edge of the tooth should be included in the restoration. The restoration must be connected to the palatal side of the tooth. Contact points should not be included.

Type 3: Preparation with significant overlap of the incisal edge;

Three-quarter type. It is a preparation almost identical to that of

Jackets with a palatine or lingual return a little less apical.

Secondary objectives: At the end of our study we could specify:

- The effectiveness of the ceramic veneer technique expressed thanks to the success rates and the failure frequencies for all types of preparations combined;
- Whether there is a difference when the preparation is improved or not;
- Specify the factors that can influence the longevity of the veneer
- The technique that ensures the best aesthetic result.

Materials and Methods

Study population

The subjects are recruited from among those who come to the prosthesis department of the dental clinic of Tizi Ouzou (located 100 km from the capital Algiers). Anomaly diagnosis; color; shape; structure or minor malposition will be objectified to the naked eye during the clinical examination. Subjects comparable by one of the anomalies cited and diagnosed will be subject to treatment by one of the techniques determined by lot.

Selection criteria

Inclusion criteria: We include in the study any anterior tooth presenting:

- A typical color anomaly: Imperfect amelogenesis due to tetracyclines; fluorosis; colorations due to age, coloring of external origin (tea, coffee or tobacco) by tissue infiltration; discolored teeth without loss of substance;
- An abnormality of shape: microdontics; atypical form of the conoid incisors;
- An abnormality of structure or texture: dysplasia, dystrophy, erosion, attrition, mechanical or chemical abrasion and coronary fracture;
- A minor rotation-type mal position.

Our study will concern both men and women, but whatever the case, we will only include patients considered reliable, cooperative likely to be followed regularly:

- General condition: Healthy patient with no general or local pathology;
- Oral hygiene: Must be satisfactory;
- Type of teeth: To reduce the variants, we will limit ourselves to the incisor-canine block.

Criteria for no-inclusion:

We will eliminate from our study anyone:

- Deemed unable to understand the essay, uncooperative or unstable.
- Presenting a contraindication to bonded ceramic veneer, namely: Elderly teeth; abraded teeth; presence of parafunctions; unfavorable occlusal reports; poor oral hygiene.

Sample: The calculation of the number of subjects required corresponds to the theoretical staff essential to highlight the expected difference between the different types of preparation. The sample size of our study will be calculated from the formula of clinical trials. This formula includes only two groups; whereas our clinical trial requires three groups we propose to proceed as follows for the calculation of the sampling we will organize two groups:

Group A: Corresponds to the supposedly superior technique A which is the type III preparation technique "with significant overlap of the incisal edge".

Group A': Corresponds to the two other techniques.

Group B which is type of preparation I: Without incisal covering.

Group C which is type of preparation II: With slight incisal covering.

We propose a success rate of technique A of 80% with a superiority of 20% to the two other techniques combined, which leads us to use the following formula to obtain the minimum number n of each group:

α: Represents the risk of the first kind: it is the risk of being wrong in finding a difference between the two groups; this is a standard set at 5% =0.05 "The 95% confidence interval".

β: Represents the risk of being wrong by not showing a difference between the two groups; it is set at 10% =0.10.

The power of our study P follows: P=1-β =90%.

- ε: Is given by a statistical table according to the value of α and β.
- P_A: Percentage of success with the type of preparation in group A=80%.
- $P_{A'}$: Percentage of success with group A' "preparations of group B and C" it is equal to 60% since the expected difference between groups A and A' is 20%.
- Are given by a table according to the value of P.

The application of the formula with the previous data gives an n of 50.8 teeth or 51 teeth/group. But we have to take into account possible "lost to follow-up" so we are going to take 60 teeth per group.

Methods

Type of study: Our study is a randomized clinical trial to compare three types of coronary preparations for bonded ceramic veneers. During this test, the allocation to the different treatment groups is carried out at random, by lot, thus ensuring the comparability of these groups.

Technique for making coronary preparations: All the clinical stages of the ceramic veneers carried out in the study (dental preparation, bonding and control) were carried out by the same practitioner. The ceramic veneers were manufactured by a single technician who used the same technique and the same ceramic to avoid manufacturing bias. The clinical stage begins with the practitioner's establishment of a clinical file to list the information necessary for the study. This sheet is completed by taking photographs before any dental preparation, to allow us to archive the case and give the necessary information to the prosthetic.

Before any prosthetic intervention, we start with preoperative steps: Such as motivation for hygiene; the rehabilitation of the oral cavity: Scaling; pulp vitality tests; sounding of the gingivo-dental

furrows and repair of the old fillings if necessary. Once this step is completed, study models are made from preliminary impressions made using an irreversible alginate hydrocolloid.

The study of these models will give us the dental formula and information concerning the static occlusion: Over jet, overbite, molar class, canine class, incisal covering etc. These models will be archived and constitute the patient's file.

We then go on to the preparation of the teeth, for this we can use two methods:

- Either the progressive reduction technique: use of grooves and a silicone key
- Either the mask technique.

We opted for the progressive reduction technique; the mask technique being applied when several teeth are involved in veneer restorations to align the teeth for example; whereas in our study we sometimes had to treat a single tooth.

We start with the realization of a high viscosity silicone key for this we must cover at least one tooth on each side of the tooth concerned by the preparation to have good stability. Then we will cut this key vertically to check that it fits correctly.

Once the key has been made, we move to the size of the tooth concerned using an air turbine; whatever the case; using strawberries from a Komet France® box marketed under the name of "box for ceramic veneers". This box contains three strawberries:

- A ball bur milling cutter whose references are (801, 314, 018)
- A bur with green ring leave, the references of which are (6856, 314, 018)
- A red ring flame cutter for finishing, the references of which are (868, 314, 012).

The horizontal grooves are made by means of the ball milling cutter which will determine the depth of the preparation. This depth is estimated to be sufficient when the chuck of the cutter comes into contact with the dental surface. The cutter used has a diameter of one millimeter and its penetration until contact with the mandrel will correspond to a depth of 0.5 mm. Each tooth has three planes on the vestibular side: A cervical plane, a median plane and an incisal plane. A groove is made on each plane. In certain cases where the teeth are small (distance taken between the free edge and the collar), only two horizontal grooves will be made.

Then place the cutter in green ring leave and remove the persistent enamel bridges between the different grooves. The leave cutter used is a cutter with a working end, its use at the cervical level will lead to a draft of the preparation limit which will initially be at a distance from the gingival ring. Once the enamel bridges have been removed, either the dental fluorosis has disappeared, giving way to a dental surface of ordinary shade and in this case we opt for a supra-gingival cervical border, or the shade remains always dark and then in this case, it is better to make a juxta-gingival limit. This kind of preparation concerns type I (without palatal return).

Regarding type II; the dental preparation previously described will be continued by reducing the free edge with the cutter. The palatal concavity will be reduced to the palatal level, always using the same cutter, and at the same time a fine leave will be drawn which will form the limit at this level. The preparation is completed by ensuring continuity between the vestibular side and the palatal side to have sufficient thickness for the ceramic. For type III (in semi-jacket) the preparation is the same as that of type II but it will be pushed further in the palatal direction to end just before the cingulum.

For these last two types of preparation, type II and type III, care should be taken to objectify with blue paper the impact of the opposing tooth to prevent the tooth-ceramic junction from being at this level. For the three types of dental preparation, the finishing will be done in the same way and will consist of the elimination of all sharp angles using a flame burr with fine grain size red ring. No preparation will be polished.

Once the preparation is finished the silicone key is positioned and we will check the homothetic aspect. The final impressions were taken according to the wash technique using a high viscosity silicone rebase with a low viscosity silicone.

The provisional restorations were made with the armchair, modeling with the fingers of the light-curing composite (Arabesk, Voco, lot n°1236135). We took care to stay away from the gum to avoid any bleeding which could compromise the bonding session. The occlusion is checked during the different mandibular excursions. The patient should not be released until he has received a number of instructions and the main emphasis is placed on the importance of good oral hygiene.

For the realization in the laboratory, all the veneer were developed with the same low-melting ceramic (Finesse® All-Ceramic, Ceramco; USA). It was treated using the layering technique using the conventional lost wax method and following the manufacturer's instructions. The models were cast with extra hard plaster and are used in one piece. After placing the wax models in the coating cylinders, the latter were preheated in a conventional preheating oven (type 5636; KaVo Dental GmbH, Biberach, Germany) to a final temperature of 850°C. The ingot of ceramic was pressed in the preheated hollow mold (EP 500 oven, Ivoclar Vivadent, Schaan, Liechtenstein) at 910°C to 920°C.

The coating rolls as well as the ingots were placed in the center of the press furnace and pressed at a temperature of 1050°C. The pressed veneers were separated from the sprues with a disc. The adjustment of the veneer was checked on the master models. Two glazing procedures were carried out in a porcelain firing oven. The lower surface of the veneers is treated with 5% hydrofluoric acid; contained in the ceramic box used; for 60 sec and neutralized in a bicarbonate bath then the veneers are dried.

We move on to bonding the veneers for this, we begin by depositing the provisionals using a probe. If the composite persists on the tooth we will do a surfacing with a bur, being careful not to touch the tooth. Then we proceed to cleaning the dental surfaces and trying the veneers. For the choice of glue, we took as reference the work of Hikita, who assessed the adhesion strength to enamel and dentin, different glues tested with different adhesives. This study shows that the best results are obtained by bonding composites requiring the use of an adhesive system preceded by etching [30].

We therefore used a dual composite: a mixed adhesive resin, which can offer, thanks to porosities, a potential for damping stresses additional to that of only photopolymerizable resins [31,32]. Once the veneer are deemed satisfactory, they are washed with water to remove the “liquid strip” which is water-soluble, they are air dried and then a

silane agent is applied with a brush (Monobond S; Ivoclar Vivadent) (the veneer is already etched in the laboratory), let it act for 1 min then it is dried. An adhesive layer (Excite® DSC, Ivoclar Vivadent) is again added to the silanized surface without light-curing, the veneer thus prepared is protected from light in a metal box.

All the veneers were glued with Variolink II ® (Variolink II, Ivoclar Vivadent, lot n°M10683, lot n°M34435, lot n°P22457), a dual hardening composite prepared according to the manufacturer's instructions. The preparations were isolated using cotton rolls combined with effective saliva suction. The surfaces of the teeth were cleaned with a rubber cup filled with a fluorine-free polishing paste mounted on a contra-angle, then washed, dried and etched for 15 seconds with a 37% phosphoric acid gel (Total Etch; Ivoclar Vivadent) then, using a water jet, they are washed for at least 15 sec.

The surface thus treated is air dried, avoiding drying of the dentin. The adhesive (Excite® DSC, Ivoclar Vivadent) was applied with micro brushes, rubbing gently for 20 sec to 30 sec, then distributed using an air jet for at least 10 sec to facilitate penetration into the dentine. Also thanks to the air jet the residual solvents will evaporate and also allow the formation of an adhesive film which will leave the tooth surface shiny. The dual composite is mixed just before use. It is applied; it is polymerized for 10 seconds with light with an energy density of 480 mW/cm^2 (Optilux, Demetron; Danbury, CT, USA) at the incisal edge to ensure the stabilization of the facet and to be able to easily remove excess composite.

The complete polymerization is carried out section by section for 40 sec, starting with the proximal areas. Once the polymerization is complete, we proceed to the verification by means of a probe of the edges of the veneer in search of possible excess of composite, particularly in the interdental spaces. Verification of the occlusion in the static and dynamic state. After balancing all the touch-ups made to the surfaces are polished. Before releasing the patient, care should be taken to mention the contact of the opposing tooth with the veneer: contact can be made:

- On the palatal side;
- On ceramic with 1/3 incisal;
- On ceramic at 1/3 medium;
- On the incisal edge;
- No contact.

The patient's appreciation will also be mentioned to assess the degree of satisfaction which can be: n-Control sessions. Patients are invited to follow-up sessions after: 6 months, 12 months, 24 months, 36 months, 48 months and 60 months.

During these meetings, the veneers were visually inspected and evaluated according to the criteria studied.

Information concerning mechanical failures is reported, specifying the date of the failure and taking care to attribute to each failure the circumstances of occurrence to find out the cause and specify the alternative treatment that was used as a solution to this problem failure.

For mechanical failures, a table must be completed, either:

- Success: No delamination, crack or fracture event;
- Failure: Which may or may not be repairable.

If it is not repairable, we specify the alternative treatment that we have established for the patient. Above all, the cause of the failure is specified.

Peeling: It is specified whether the bonding composite has remained on the tooth, on the veneer or on neither. We specify if we have glued the recovered facet or with what we replaced it otherwise.

Fracture: Which can be a fracture of the tooth; in this case we take a retro-alveolar X-ray to check the state of the root and we specify our course of action in this case. If the fracture concerns the veneer we specify if it is axial or at the free edge and especially the circumstances of this event.

Crack: If it is visible, whether or not there is an impact on the aesthetic appearance of the veneer one; medium or good.

Statistical study

The data processing and analysis was carried out by computer software, in particular by Epi-Info version 6.04 for the univariate analysis and the SPSS 17 as well as the R in its version 3.1.0 for the survival analysis. The computer control of the EPI-INFO version 6.2 software (check module) was used to avoid data entry errors.

- The quantitative variables were represented by: the mean, standard deviation, the ranks;
- The qualitative variables were represented by the frequency observed with its standard deviation.

We used:

- Student's test to compare two quantitative variables;
- The Chi-square test to compare two qualitative variables and Fisher when the conditions of use of the Chi-square test do not allow it (when the expected theoretical variables are <5).

The analysis of the delays in the occurrence of failures in the three treatment techniques (separation, fracture, etc.) were studied using the Kaplan-Meir survival analysis method. Any form of clinical

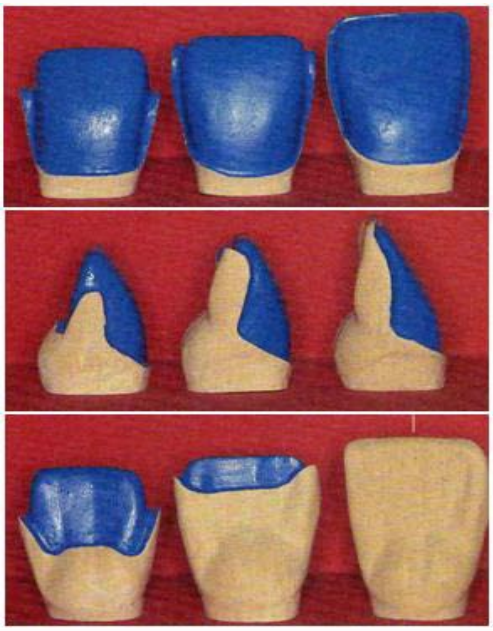

Figure 1: The three types of preparation for ceramic veneers on maxillary anterior teeth.

Figure 2: Clinical case: Class I dental fluorosis of Dean.

Figure 3: Final result after bonding of the veneers.

Figure 4: Before and after restoration by facets.

failure has been recorded as an "event". The comparison of the survival curves used the Log-rank test and the Cox regression. The significance level of the statistical tests used is 0.05.

Clinical cases

From the study inclusion circles, the patients treated by facets presented anomalies:

- Texture "fluorosis";
- Position "light malpositions";
- Lateral agenesis, mesial canine.

These clinical cases illustrate these various anomalies.

A 23 year old patient is presented to our consulting room with an aesthetic oak due to the presence of dental fluorosis (Figure 2). The clinical examination reveals a class I fluorosis according to the classification of Dean which regroups 4 classes. The patient was informed of any therapeutic solutions, namely: micro abrasion, whether or not associated with lightening, and ceramic facets. The patient opted for treatment with ceramic veneers; the first two solutions did not work for his brother who has the same problem. The patient received explanations concerning the treatment with ceramic veneers, insisting on the fact that these teeth which do not show any loss of substance will be cut and this is irreversible. Once informed consent has been approved by the patient; we start by filling in the clinical file and drawing lots to determine the different types of coronary preparations (Figure 3 and 4).

Results

The presentation of the results consists of two parts:

- A descriptive part where the characteristics of the patient and the facets are described by the method of descriptive statistics.
- An analytical part where we will compare the different variables according to the techniques used and we will try to explain the differences by applying statistical tests.

Descriptive study

In this study 264 veneers were placed in 73 patients represented by 52 women and 21 men. The average age of patients at the start of treatment was 27 years with a range of 13 to 49 years. The number of facets varies from "one" to "six" per patient. All facets were made at the level of the upper anterior block. Once the treatment is over, patients are invited to come back if there is a problem with their veneers or their abutment teeth. All the patients participated in the various controls, only one patient, who benefited from two restorations at the central level did not participate in the study and this from the second recall (12 months), which is equivalent to a rate 1.40% of patients abandoned or lost to follow-up (0.76% of restorations).

Table 1: Number of veneers according to the type of tooth prepared.

Tooth type	Numbers	Percentage
Centrale	120	45.45%
Latérale	86	32.58%
Canine	58	21.97%
Total	264	100.00%

Table 2: Frequency of veneers by type of dental preparation.

Preparation	Numbers	Percentage
Type I	87	33.00%
Type II	92	34.80%
Type III	85	32.20%
Total	264	100.00%

Table 3: Frequency of cracks, fractures and detachments of veneers by type of dental preparation.

Dental preparation	Cracks, fractures and detachments of veneers		Total
	No	Yes	
Type I	81	6	87
	93%	7%	100%
Type II	86	6	92
	93%	7%	100%
Type III	83	2	85
	98%	2%	100%
Total	250	14	264
	94.70%	5.30%	100%

Table 4: Cracks, fractures and detachments of the veneers distribution.

Dental preparation	No cracks, fractures or detachments	cracks	Fractures	detachments	Total
Type I	81	0	2	4	87
	93.10%	00.00%	2.30 %	4.60%	100.00%
Type II	86	0	2	4	92
	93.49%	00.00%	2.17%	4.34%	100.00%
Type III	83	1	1	0	85
	97.64%	1.18%	1.18%	00.00%	100.00%
Total	250	1	5	8	264
	94.70%	0.38 %	1.89 %	3.03 %	100.00%

Descriptive study related to prosthetic restoration:

Presentation of the veneers: Number of veneers according to the type of tooth prepared (Table 1). The 120 central incisors (11 and 21) were treated with ceramic veneers, which represent a percentage of 45.45% of all the veneers. 32.58% represents the percentage of the lateral treated by facets while the canines represent only 21.97% of the whole.

Description of veneers according to the type of dental preparation: Frequency of veneers by type of dental preparation (Table 2). Our sample of 264 veneers is distributed according to the type of dental preparation as follows:

- 87 teeth were prepared according to type I "without palatal return"; which is equivalent to 33% of the veneer.

- The majority of teeth; 92 in number; were prepared according to type II “slight palatal return” which corresponds to 35% of the veneer.

- 85 teeth received a type III preparation "large palatal return" which represents a percentage of 32% of the veneer.

The occurrence of cracks, fractures and detachment of the veneers according to the three types of preparations (Table 3 and Figure 5). Type I and Type II preparations experienced the same percentage of cracks, fractures and detachments: 7% within each of the two groups; whereas 2% of the facets which were restored according to type III showed cracks; fractures and detachments. These cracks, fractures and detachments of the veneer are distributed as follows in Table 4.

The veneers restored by type III experienced a single crack and a single fracture (Figure 6). On the other hand, those restored by type I and II experienced not only the same frequency of events, namely 6 for each, but the same nature of events, namely: 2 fractures and 2 detachments for each.

Description of the action to be taken in the event of a crack, fracture or detachment of the veneers (Table 5). When a crack, fracture or detachment occurs, driving will depend on the impact and importance of each of these events. For example in the event of detachment, if the veneer was recovered and if it was still intact; it was re-glued but will no longer be included in the clinical trial.

While another veneers which came off and fractured; was either redone with another type of dental preparation (which is no longer included in the clinical trial) or the patient was treated with another type of prosthetic restoration. This is why for events (cracks, fractures or detachments) of the same nature the course of action was not the same. In our study, 245 veneers, 92.80% are qualified as clinically satisfactory. These are veneers that have always remained in the mouth and that have not shown any problem. While 8 veneers, that is to say 3.03%, manifested problems which were repaired and still remained in the mouth. On the other hand 11 veneers were absolute failures and had to be redone which is equivalent to 4.17%.

Table 5: Frequency of veneers following the course of action.

Veneers’s Quality	Frequency	Percentage
Clinically satisfactory	245	92.80%
Relative "fixable" failures	8	3.03%
Absolute failures	11	4.17%
Total	264	100.00%

Table 6: Percentage of veneers according to the occurrence of cracks, fractures and detachments.

Cracks, fractures and detachments	Number	Percentage
Yes	14	5.30%
No	250	94.70%
Total	264	100.00%

Analytical study

Although Kaplan-Meier statistics were originally designed to deal with individuals, the use of the tooth as a statistical unit in place of the person is justified. In the present study, the Kaplan-Meier analysis was done in two different ways: The first analysis is linked to the patient; the second was carried out using the restoration as a statistical unit.

Our study is a clinical trial in which we seek to assess the effectiveness of one type of preparation compared to two other types, by comparing the results obtained in each group. Faced with an observed difference between the groups, there are two possibilities either this difference is only due to chance, or this observed difference is real. We applied the "Chi-square" test to verify the dependence or not between the variables and the different groups. This probability is called "p". The p-value is the threshold from which the difference observed is considered to be statistically significant. This means that it is real and has a low chance of being due to chance. When p is ≤ 0.05 the difference is significant and when p is >0.05 the difference is not significant.

Analytical study related to prosthetic restoration: Statistical tests will be carried out to deduce causality or not from the parameters studied on the survival of the facets on the one hand and on the biological and aesthetic quality of the veneers on the other hand.

Analysis of the survival of ceramic veneers: Failure rate of ceramic veneers (Table 6). In the present study; using the restoration as a statistical unit and after 64 months of follow-up (5 years and 4 months), only 14 veneers showed cracks, fractures or detachments

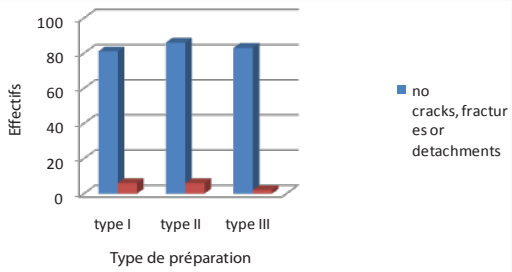

Figure 5: Histogram of the frequency of cracks, fractures and detachments according to the type of dental preparation.

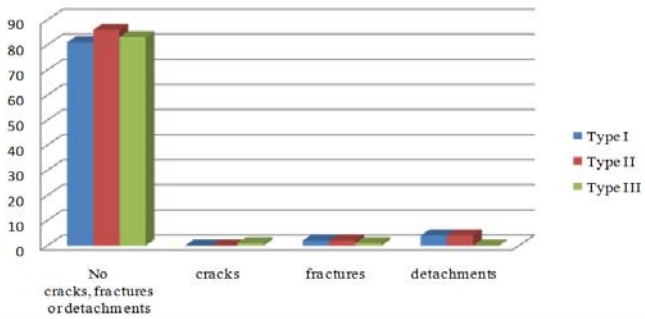

Figure 6: Histogram of the frequency of cracks, fractures and detachments of the veneerà according to the types of dental preparations.

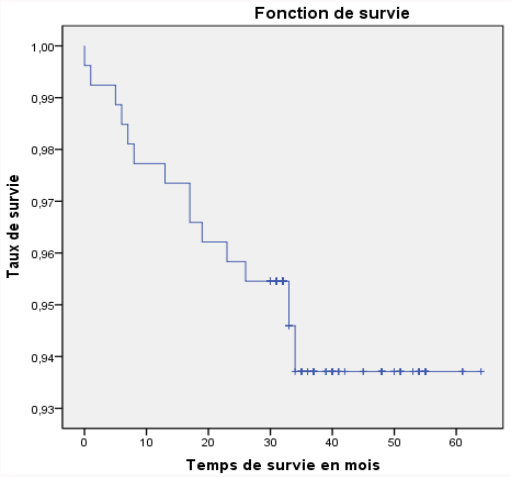

Figure 7: Survival curve of ceramic veneers.

among the 264 bonded facets which corresponds to a rate of 5.30% failure (95% CI; [2.93%; 8.73%]). Statistical analysis of survival by the Kaplan-Meir method results in a probability of survival at 5 years and 4 months of 93.7% (95% CI; [90.1%; 97.3%]).

During a clinical trial, the effectiveness of a therapy is done by estimating the duration of survival. By definition, survival time is the time that elapses until the occurrence of a particular event which in our study corresponds to a crack, a fracture or a detachment. In our clinical trial, the mean veneers survival time at 5 years and 4 months is 61.1 months.

The survival of ceramic veneers (Figure 7). The survival curve is the most used representation to describe the dynamics of occurrence over time of events. It represents, as a function of time, the survival rate, i.e. the proportion of the facets initially included in the trial; still

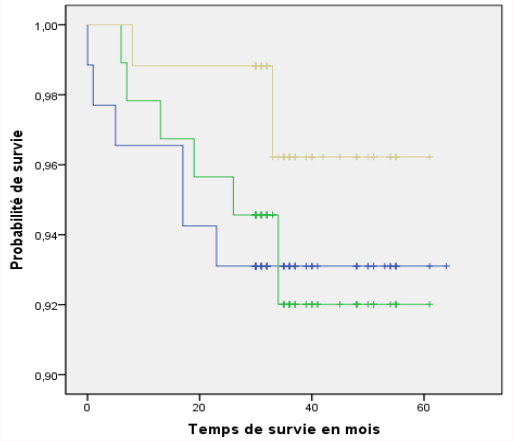

Figure 8: Survival curve of ceramic veneers according to the type of coronary preparation.

in the mouth at time t. In other words, it is the probability of survival until time t.

It is a staircase curve with a step corresponding to each event. The height of the step is proportional to the number of events over the interval. The survival curve has two dimensions, and therefore two possible readings (horizontal reading and vertical reading). The horizontal reading consists in determining on the ordinate axis the probability of survival which interests us. We draw a line vertically until we cross the survival curve, and we look at the correspondence on the abscissa axis which then gives us the time corresponding to this probability of survival.

For the curve of our study; at time t=0 months; the survival rate was 100%, which corresponds to a probability of 1.

This rate fell over time to 95.50% in the 25th month and from the 33rd month onwards it stabilized at 93.70%. From this curve, it can be said that the cracks, fractures and detachments were recorded during the first 30 months.

From the 33rd month no event occurred.

Analysis of the veneers according to the type of preparation:

The occurrence of cracks, fractures and detachments according to the three types of preparations (Table 7). The 14 recorded cracks, fractures and detachments are distributed according to the type of dental preparation as follows:

- 6 for preparations of type I "without palatal return" and of type II" slight palatal return" which corresponds to a percentage of 42.86% of all cracks, fractures and detachments for each of types I and type II.

- 2 for type III preparations "large palatal return" which corresponds to a percentage of 14.28% of all cracks, fractures and detachments of the facets.

Note that type III has fewer events than the other two types I and II which have manifested events equally. The frequency of occurrence of events for type III was 1/3 of the occurrence of events compared to each of types I and II. The difference between type III and the other two types is numerical, not statistical. Effectively; the Chi-square test “type of preparation/cracks, fractures and detachment of the facets” gives a p=0.53 (p>0.05). There is no significant difference between

Table 7: Type of dental preparation according to cracks, fractures and detachments.

Cracks, fractures and detachments	Type of dental preparation			Total
	Type I	Type II	Type III	
Yes	6	6	2	14
	42.86%	42.86%	14.28%	100.00%
No	81	86	83	250
	32.40%	34.40%	33.20%	100.00%
Total	87	92	85	264
	33.00%	34.80%	32.20%	100.00%

the three types of coronary preparations as regards the occurrence of cracks, fractures and detachments.

Survival rate of ceramic facets according to the three types of coronary preparations (Figure 8). At the start of the curve, 100% of the veneers were in mouths (the probability was 1). From this curve we can deduce that:

- The survival rate is 93.10% (95% CI; [87.90%; 98.60%]) for ceramic veneers restored with type I "without palatal return" with an average survival time of 60.31 months; (95% CI; [57.42 months; 63.20 months]).

- The survival rate is 92% (95% CI; [85.60%; 98.60%]) for type II facets "slight palatal return" with an average survival time of 57.77 months (CI 95%; [60.31 months; 55.22 months]).

- The survival rate is 96.20% (95% CI; [90.90%; 100.00%]) for type III veneers with an average survival time of 59.64 months (95% CI; [59.95 months; 62.60 months]).

Discussion

Our study; is a randomized clinical trial comparing three types of coronary preparations for bonded ceramic veneers.

We are interested in the role that the design of coronary preparation can play on the longevity of ceramic veneers.

These restorations, whose translucency meets current aesthetic requirements, are more and more requested but little information, little clinical work is available on this subject [33-35]. The size of our population includes 73 patients. The analysis of our sample shows a predominance of the female sex with a number of 52 women which represents 71.23% of the total workforce and 21 men who represent 28.76%. This predominance of the female sex is explained by the veneer that women are more concerned with their appearance than men [36]. They are aware of the role that a beautiful smile can play. Knowledgeable they demand the aesthetics but also the least mutilating size possible of their teeth [37].

Our results are consistent with the study by Dumfabrt Herbert, where the majority of patients were female (60%) [38]. It also confirms that these results have been reported in other clinical evaluations on ceramic veneers. The average age of our study population is 27.71 years. The median age of the sample is 27 years with a minimum age of 13 and a maximum of 49 years. This is a young population: At this age range, patients are very concerned about their appearance, which is confirmed by the study by Hamzawi-Decharrière and cited by Vu, where they announce that the aesthetic demand in the next five years will represent 60% of the reasons for consultation, especially in young patients.

The survival rate of ceramic veneers

In the present study; using the restoration as a statistical unit 14 veneers showed cracks, fractures and detachments; among the 264 facets glued, which corresponds to a failure rate of 5.30% (95% CI; [2.93%; 8.73%]). Statistical analysis of survival by the Kaplan-Meir method results in a probability of survival at 5 years and 4 months of 93.70% (95% CI; [90.1%; 97.3%]) and an average survival time of 61.1 months (95% CI; [59.59 months; 62.6 months]). Almost all studies use the veneers as a statistical unit.

Clinical studies [39,40], have reported a survival rate of more than 90% after 4 to 10 years of follow-up. Most studies on the clinical survival of ceramic veneers over a period of less than 5 years report survival rates varying from 48% to 100% [41]. Other studies [36], have reported a low failure rate (0% to 7%). The highest failure rates (14% to 33%) have been noted in clinical trials that involve pre-disposing factors such as occlusion, excessive loss of dental tissue, use of inappropriate bonding, unprepared teeth, and partial adhesion of large exposed dentin areas.

In a retrospective evaluation

At 36 months Rinke reported that the survival rate for bonded ceramic veneers was 92.10% [42]. At 5 years Murphy et al. [33] reports a success rate of 89%; while Pippin cited by Burke [34] report that the rate was 100%. The data published to date concerning the survival rates and the durability in the mouth of ceramic veneers are in agreement with the result obtained by our study concerning the survival rate of ceramic veneers over a period of 5 years.

Frequency of cracks, fractures and detachments

The failure rate found in our study is estimated at 5.30% at 64 months and manifests itself as follows: A single crack was found, which corresponds to 0.39% of all veneers and 7.14% of all veneers events encountered. The crack occurred 9 months after bonding of the veneer just before the second check. Stuck on the 21 which is healthy, alive, in a patient who does not have bad habits, who avoids incision with the teeth.

The veneer in question has a type III design and the seat of the crack is at the level of the palatal return on the distal side. The contact of the opposing tooth is at the level of the ceramic at 1/3 medium (the seat of the crack). The fissure being invisible (at the palatal level) was not detected by the patient. It is noted that the cracked veneers should only be replaced if the cracks are frankly unsightly (deeply colored) and at the request of the patient. In our case the veneer was not replaced and the patient continued to come to the periodic inspections during which it was noticed that the crack did not evolve.

It should be noted that this patient was treated by two veneers at the central level. As for the facet at the level of the 11 which is also identical; alive; was designed according to type II without any contact with the opposing tooth.

This veneers remained intact until the last check. This result is consistent with the clinical studies of Magne and Obster who have shown that facet restorations with cracks but which are still bonded; can remain stable for years; which can be compared to cracks in the enamel of natural teeth.

Petra et al. [35] reported in a clinical study on the clinical evaluation of ceramic veneers with palatal extension over a period of 5 years that the cracks occurred in two restorations with overlap (4.70%) in the palatal region on the side distal-incisor and at the level

of a semi-sheath veneer restoration (4.10%) in the disto-vestibular zone. They report that similar cracks in the overlapped restorations have been observed in previous investigations. They concluded that the IPS Empress® facets in half-jacket showed a relatively low number of cracks compared to the facets in semi-jacket in feldspar ceramic.

While Magne, in their study state that cracks had occurred in 12% of restorations after 4.5 years; of which 10% had slightly extensive cracks and 2% were clearly visible. Mainly these cracks formed in the palatal region, and some in the vestibular side. Lobster found in a clinical study cracks in 2.8% of IPS Empress® veneers with incisal covering after 4.5 years. As for Peumans et al. [36], they report in a clinical study; that the frequency of cracks at 5 years was 2% and increases to reach 21% at 10 years. He noticed a marked increase in visible vestibular and palatal cracks due to prolonged chewing loading time. They conclude that the formation of cracks in the ceramic veneers can be improved by the palatal and proximal extension of the preparation, the location of the edges of the restoration, the occlusal contact points, and the thickness of the adhesive layer and of the ceramic itself.

As a solution to prevent the appearance of cracks, it has been established that it is important to carry out a controlled and uniform reduction of the tooth. More; a sufficient and uniform thickness of the ceramic combined with a minimum thickness of bonding composite and a favorable ratio between the thickness of the ceramic and that of the bonding composite greater than 3 will minimize the appearance of cracks.

Before drawing any conclusion regarding cracking, it should be decided to what extent the cracking should be considered a failure. You should know that cracking is an inevitable phenomenon of the aging of brittle laminate materials. As in the case of enamel, cracking turns out to be a natural process of protection against tensile stresses, and intact teeth have many cracks in the enamel which are absorbed by the amelo-dentinal junction, which acts as a crack stop due to its particular architecture characterized by the arrangement of collagen fibers.

Despite the continuous improvement of ceramic materials; cracks remain their biggest flaws. The sintering process can cause residual stresses and structural defects in the ceramic material. More; the residual stresses in the ceramic and /or in the bonding system favor the formation of micro cracks and their evolution. The crack can also be caused by the polymerization shrinkage of the bonding composite, which creates stress concentrations at the adhesive-ceramic restoration interface. Exposure to temperature variations between 0°C and 67°C induces a different thermal expansion rate in the bonded materials and thus contributes to weakening not only the quality of the bonding, but also the ceramic restoration.

An "*in vitro*" study of ceramic veneers by Magne cited by Peumans on the thermal and mechanical stress of ceramics revealed that an increasing number of thermal cycles caused an increase in the formation of cracks [37].

In our study the result on the plane "crack" is included in the intervals of the results reported in the cited studies. The seat at the level of the fissure at the level of the palatal face and the distal side is in agreement with what has been reported by these studies. The cause of this crack is probably due to the impact of the opposing tooth at this level.

The second type of failure studied is fractures with a percentage of 0.76% of all veneers and 14.29% of all veneers events encountered.

We can meet two forms of fractures:

- An axial fracture known as adhesive;
- A fracture of the so-called "cohesive" free edge.

Many authors have found that fractures are the most common cause of clinical failure of ceramic veneers. They incriminate the non-compliance with the thicknesses, the incorrect adjustment of the occlusion, or the presence of a parafunction. They consider that ceramic is the weakest link in the adhesive complex: Veneer/glue/tooth [7].

In our study; we recorded two axial fractures which represent 14.29% of all veneers events encountered Fracture #1 is due to sudden contact with an olive pit. This same patient presents another ceramic faceted restoration on the 11 (closed obturator), of a type I design and whose contact with the opposing tooth is on the palatal surface and which has always remained in place.

Patient #2 reports that the fracture was due to an accidental shock received during a game. There was a sharp axial crack extending from the free edge of the facet to the neck. The two fragments of the facet remained glued, which gave the impression of an unsightly crack on the vestibular side. But after a week there was the detachment of the distal fragment of the veneer that the patient recovered, the other fragment remained attached to the tooth.

This patient was treated by 4 veneers at the level of the incisor block. All veneers were bonded to healthy teeth with dental fluorosis.

- The veneer on type 13, the contact with the opposing tooth is on the palatal side.
- The veneer on the 21 type III whose contact with the opposing tooth is on the ceramic with 1/3 incisal.
- The veneer on Type II 22 which has no contact with the opposing tooth.

These three veneers remained in the mouth until the last check. Most authors explain the appearance of the so-called adhesive axial fracture; by the presence of external stimuli or the existence of a lack of adhesion. In our study; the fractures observed are due to a shock with an absence of adhesion; detachment concerns a large part of the veneer while the residual part, the smallest, remains in place on the tooth. For these two patients, who presented axial fractures in the veneer; there is a common factor: The presence of an external shock. Concerning the fracture at the free edge or "chipping"; it represents 1.14% of all veneers and 21.43% of all veneers events encountered.

Chipping; "chipping" or delamination is defined as a cohesive fracture which occurs in the ceramic during very localized and intense loads (in general during a trauma or an accidental bite) generally on the free edge of the veneers [16].

When the bonding is carried out correctly, only a small ceramic flake occurs, most of the veneers are preserved. Chipping phenomena are still poorly understood and seem to occur even through chemically intact ceramic [43]. When there is an error in the preparation of the tooth and you leave sharp angles, an internal crack can form. If the ceramic veneer is very well bonded to the tooth, this internal stress is manifested only by a crack. But internal stresses can also cause the ceramic to shine where it is less well bonded. Iatrogenic factors can also cause cohesive fractures [44].

An "adhesive" rupture fracture generally appears after external stimulus and manifests itself by the fracture of a large part of the restoration while the other part still remains adherent to the tooth. A "cohesive" fracture involves a small piece of the veneer that is chipped, leaving most of it intact. In both cases, the studies incriminated the unfavorable occlusion and the para-functions especially bruxism. Several works have addressed free edge fractures; Çöterta et al. [26] report in a clinical study that chipping or partial detachment has been observed in preparations where there has been dentinal exposure.

Other authors have conducted a 10-year clinical study (1984-1994); more than 90% of these fractures involve the angles or the occlusal edge. It is very rare to see cervical fractures or fractures of the vestibular faces. In turn Fradeani [43] reported splinters at 1.20% of the IPS veneer after 6 years. Similar results for feldspar ceramic were obtained by Dumfahrt and Schaffer [45] (2% after 10 years) and Peumans et al. [36] (9% palatal after 10 years). Friedman [44] in a 1998 study on a large number of restorations shows that most fractures occurring in the treatment of ceramic veneers are cohesive.

Petra et al. [35] in their study only recorded two of the veneer in a semi-jacket (8.30%) which showed cohesive palatal fractures. They conclude that the shavings. Incisors, attributed to excess loading, have been observed with the same frequency in other clinical studies which have shown that minimal ceramic cohesive fractures (splinters) have occurred mainly at the incisal edge due to concentrations of functional or palatal stresses. Four overlapping veneer demonstrated cohesive fractures (total 9.50%: Incisor 2.40%, 4.80% palatal and vestibulo-cervical 2.40%), which were clinically acceptable.

Magne observed cohesive ceramic fractures in 20% of the veneers covered with feldspar ceramic after 4.5 years and Nordb observed the clinical performance of ceramic veneers without incisal overlap over a period of 3 years. They estimate that incisal flaking occurred in 7 veneers among the 135 bonded veneers. Addison quoted by Schmidseder [9] concludes that cohesive fractures are located within the cosmetic material and the surface state of ceramic plays a major role in the initiation of defects whose propagation leads to fracture. If the margin of the incisal preparation is placed at the junction of the buccal and lingual surfaces on the incisal edge, cohesive fracture can occur.

In our study; bruxomaniac patients are not included. The flaking was recorded in a young patient who had a para-function that the examination did not reveal and that the clinical examination did not reveal "absence of wearing surfaces". The margin of the incisal preparation is placed at the junction of the vestibular and lingual surfaces on the incisal edge (type I); the patient cringes before sleeping. The flaking was quick; however the other two patients did not have para-functions.

No common factor connects the three patients. We believe that the surface finish of the ceramic as well as the presence of para-functions is responsible for this flaking. The low fracture rate reported in our study can be explained by the fact that we immediately excluded all patients with a parafunction more we used a pressed ceramic which is at least twice as strong as the feldspar used in a lot of research work, because pressed ceramic restorations are much more durable.

In our study; we mainly observed veneer detachments which represent 57.14% of all events. Interrogation on the circumstances of the occurrence of this separation revealed that:

- The first detachment; occurred at the time of the incision; the veneer peeled off and was lost. The other 5 veneers glued in this same patient did not experience any event.
- The second detachment occurred when the patient exerted traction on the tooth while eating. The veneer was thrown out of the mouth and fractured following the impact. The bonding composite remained at the veneer.
- The third detachment occurred in the patient during the meal. The other 4 veneers bonded in this patient remained without event.
- The fourth occurred in a patient who constantly uses a toothpick after each meal. When he was using the toothpick inserting it between 23 and 22 with the veneer, the veneer came off. By examining the veneer we realized that the bonding composite remained at the level of the veneers. The other 5 veneers stuck in this patient remained without event.
- The fifth occurred in a patient who stated that there were no special circumstances. The 3 other veneers glued in this patient remained without event.
- The last three detachments occurred in the same patient; who was biting his nails constantly. This was confirmed during the clinical examination.

The veneer glued to 11 in this patient remained without event. About detachments; Cöterta et al. [26] by studying 200 veneers in 40 patients report that the most frequent cause of failures was detachment (11 of 12 failures) while Friedman [44] reported that among the 7% of failures recorded on 3700 veneers only 11% were due to detachment. It concludes that detachment is a rare cause of failure and is most often the result of an implementation error during the various surface treatments. Dumfarth and Schäffer [45] confirmed this finding in 2000. D'Arcangelo, in the recent study spanning 7 years reported that there was no delamination; result confirming the results of Peumans et al. [36].

The detachments appear when large parts of the preparation have exposed the dentin or when the veneers are linked to the unprepared enamel. Peeling can also occur if there is contamination during the bonding process, regardless of the percentage of the enamel layer intact [26]. It can also be an adhesion problem, improper etching of the ceramic, and an error during the bonding procedure or the presence of excessive stress important during the function. Nowadays this cause of failure is the least frequent because the bonding techniques have clearly improved.

When there is detachment, the reason for the failure must first be sought at the surface of the preparation [15]. If it appears clean and without bonding composite, the problem lies at the tooth-bonding bonding interface. When treating the tooth surface before bonding, the failure may be due to etching; the application of the primer, the adhesive, the photopolymerization or the contamination of the dental surface during one of these stages. In our study, detachments represent the most frequent failure. A common factor between the different patients was found: They all incised with the teeth.

In 7 out of 8 detached veneers had contact with the opposing tooth the other facet had no contact with the opposing tooth. These detached veneers were subjected to tensile stresses during a meal. For the eighth veneers, the patient did not mention any particular causes. The Chi-square test confirms the link between detachment and incision of food. The detachments are encountered at the level of type

I and type II preparations at a rate of 50%, 50%. While the veneers with a type III preparation did not experience any delamination. The bonding composite remains integral with the facets, which means that the weak link is located at the tooth-bonding bonding interface, which is correlated with Rinke's study.

In this study, 50% of the facets that have come off have a depth of the preparation in the dentin while the other 50% have a preparation in the enamel. In our study, the depth of the preparation was not used as a risk factor for detachments. The Chi-square test reveals that the difference is not significant.

Conclusion

Within the methodological limits of our clinical trial which evaluated 264 veneers bonded in 73 patients (52 women and 21 men) of an age group going from 13 to 49 years with an average age of 27.71 years and after 64 months of follow-up (5 years and 4 months) the following results were drawn:

- The incision with the teeth is a risk factor for the occurrence of cracks, fractures and detachments, Ceramics are more resistant to compression than to traction. It has been noted that the incision in these patients is not made frankly because in most cases they associate a pulling movement.
- The type of coronary preparation is not a determining factor
- The occurrence of cracks, fractures and detachments.

It is an adhesive restoration and therefore retention is ensured by bonding and not by the geometry of the preparation. On the other hand, the ceramic used is a ceramic whose mechanical characteristics allow it to withstand different stresses.

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