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FRACTURE RESISTANCE OF FELDSPATHIC VENEERS WITH DIFFERENT PREPARATION DESIGNS IN VITRO

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ABSTRACT:

Objective: The purpose of this study is to detect the effect of varying interproximal preparations of feldspathic veneers on their fracture resistance.

Methods: A sample of forty upper central incisors recently extracted, and free of caries and restorations were distributed randomly to two groups. Each one has a group of 20 teeth, the first group included the numbered teeth from 1 to 20 and prepared to receive the feldspathic veneers without extension the proximal contact area(PCA) while the second group included the numbered teeth from 21 to 40 and prepared with extension (PCA), all the porcelain veneers were luted with resin cement. The forces applied on them using the universal testing instrument (Test 114) with force vertically directed to the incisal edge of the veneer at a speed of 0.5 mm/min. The values of fracture resistance were recorded when the porcelain veneer was separated or cracked.

Results: Mean fracture resistance force for the first group was (914.0675 N) (N, mean forces) and higher than mean fracture resistance force for the second group (727.9650 N). T student test showed a significant difference between them at p≤0,05.

Conclusion: The increase in extension increases the fracture potential of the feldspathic veneers.

Keywords: Feldspathic Porcelain, Proximal Contact Area (PCA), Fracture Resistance.

INTRODUCTION:

Porcelain laminate veneers bonded to enamel were first described in the early 1980s [1,2] advances in ceramic materials, adhesive technology, and clinical techniques have enabled the porcelain laminate veneer to evolve into the treatment of choice for minimally invasive aesthetic dentistry.[3] Prudent treatment planning along with precise tooth preparation is crucial for optimal function and aesthetics. Whilst conservation of tooth structure is important, sufficient space must exist for the restoration to possess appropriate homogeneous thickness for optical properties and strength.[4,5]

It has been suggested that an even reduction of 0.5 mm provides sufficient space for porcelain veneers to be fabricated exhibiting excellent colour without undue bulk.[6]

Porcelain veneers, designed for no prepared or minimally prepared tooth surfaces, are facets with the thickness of 0.3–0.5 mm, similar to thickness of the contact lens, that what feldspathic veneers can achieve in contrast to pressed ceramic veneers.[7]

A low-fusing Feldspathic porcelain veneer with the thickness of no more than 0.3 mm can provide good fracture resistance that increases multiple times after the luting with resin cement to the

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tooth surface. The increase in fracture resistance is because of its strong bond with resin cement through the use of etching and silanizing, this strong bond with resin cement is a critical factor for the success and durability of porcelain veneers.[8,9]

By etching the inner side of the porcelain veneer with hydrofluoric acid and subsequently silanizing the etched surface, the bond strength of a luting composite to the etched porcelain surface has been measured to be higher than the bond strength of a luting composite to etched enamel and even exceeding the cohesive strength of the porcelain itself.[10,11,12,13]

There is no conclusive evidence can be found for what is the best way to prepare the interproximal area of a tooth for porcelain veneers. Options range from virtually no preparation to a preparation that stops just short of the interproximal contact to a slight opening of the interproximal contact. Breaking the contact (sometimes called the "slice preparation") may be necessary to clear the contact in certain situations, such as changing the shape or position of teeth and in the case of multiple veneers.[14]

Potential advantages of veneer preparation without the extension of the proximal contact area over the preparation with extension the proximal contact area are not strongly supported by available evidence. Therefore, the aim of this study was to compare these two veneer preparation designs by measuring resistance to fracture of feldspathic veneers. The null hypothesis was that fracture strength were not affected by Interproximal preparation design.

MATERIALS AND METHODS:

Selection of teeth

Forty caries-free, human maxillary central incisors of equal size were used as abutments. The teeth were obtained directly after extraction, cleaned and stored in distilled water at room temperature [15]from the day of extraction until testing.

Teeth were randomly divided into two groups. Each group contained 20 teeth. Two different interproximal designs of preparation were done for the two groups:

•**Group I:** included the numbered teeth from 1 to 20 and prepared without extension (PCA). (Figure 1)

•**Group II:** included the numbered teeth from 21 to 40 and prepared with extension (PCA).(Figure 2)

Silicone putty impressions were done on all of the teeth specimens before their preparation. These impressions were used as templates to evaluate the amount of tooth reduction and uniform the veneers thickness.

Mounting of teeth

Forty pre-fabricated plastic base formers of standard size were selected. Epoxy resin was used to mount the teeth. Mounting was done in such a way

that long axis of each tooth was perfectly vertical. Tooth placement was clinically judged by two persons to avoid error in mounting.[16] Mounting was up to 2 mm below cementoenamel junction (CEJ) to simulate biologic width.

Preparation of teeth

We used two lead foil to uniform the preparation size, the first foil updated to the central upper incisor with typical dimensions without extension (PCA) and used as a preparation size parameter in the first group ,while the second foil updated to the same incisor but with extension (PCA) and used as preparation size parameter in the second group.(figure 3)

The standard preparation was carried out as follows: in the two test groups the incisal edge was reduced 1.5 mm with butt joint finish line. Labial surfaces of teeth were prepared uniformly to make veneers of uniform thickness. 0.3mm reduction was done at the cervical third and 0.5mm at the middle and incisal thirds of each specimen, so that it remained mainly within the enamel.[17]

Air rotor hand piece with water spray was used for preparation. Self-limiting depth cutting discs of 0.3 mm (FG 834.O18, Horico, Germany) and 0.5mm (FG 834.O21,Horico,Germany) were used to define the depth cuts. 1.2 mm chamfer bur (FG199.O18 , Horico ,Germany) and finishing bur were also used. Tooth preparation was restricted in enamel alone and was devoid of any sharp line angle. Cervical finish lines were created in CEJ with chamfer finish line.

Fabrication of Porcelain Veneers

After preparation, impressions of the abutment teeth were taken with a polyvinyl-siloxane impression material (3M-Espe,Seefeld,Germany).
Feldspathic veneers fabricated using(IPS d.SIGN, Ivoclar Vivadent, Lichtenstein) with Refractory die technique.

Cementation of veneers

Surface treatment of all laminate veneers was done by using 10% hydrofluoric acid gel (Porcelain etch, Ultradent) according to the manufacturer instructions for 90 seconds.

The veneers were washed thoroughly with air/water spray for 30 seconds. They were dried using compressed air. Then, all veneers were primed for resin onto their inner surface using a silane coupling agent (Monobond N, Ivoclar Vivadent, Lichtenstein) for 60 seconds, then air dried and the adaper single bond adhesive (Excite, Ivoclar-Vivadent) was applied for 20 seconds with a micro-brush on the etched veneer surfaces before cementation. Surface treatment of the prepared teeth was also done by using 37% phosphoric acid etching gel (Total etch, Ivoclar-Vivadent) for 30 seconds, then the adaper single bond adhesive(Excite, Ivoclar-Vivadent) was applied for 20 seconds with a micro-brush on the etched enamel surfaces of all teeth.

A dual-cure composite resin luting agent (Variolink N, Ivoclar vivadent) was used

to lute the veneers. The paste and catalyst were mixed in a 1:1 ratio on a mixed paper pad for 10 seconds using a spatula according to the manufacturer's instructions. A thin layer of the resin cement was applied to the center of the intaglio surface of the veneer. A light finger pressure was exerted on the restoration. The excess composite luting agent was carefully removed. Light curing was performed to the facial, palatal, and incisal surfaces for 40 seconds according to the manufacturer's instructions, using a light curing unit.

All specimens were stored in distilled water at 37°C for 24 h with no thermocycling before mechanical testing.

Specimen testing

The forces applied on the veneers using the Universal Testing Instrument (Test 114) with force vertically directed to the incisal edge of the veneer at a speed of 0.5 mm/min. The values of fracture resistance were automatically recorded in Newton (N) using computer software when the porcelain veneer was separated or cracked. (figure 4)

RESULTS:

Data analysis was performed, separate analysis was performed with t-test to evaluate the significance between the two groups. Mean fracture resistance force for the first group is (914.0675 N) (N, mean forces) and higher than mean fracture resistance force for the second group (727.9650 N). T student test showed a significant difference between them at p≤0,05.(figure 5) (table 1).

DISCUSSION:

In the present study, human maxillary central incisors were selected because veneers are commonly indicated on them, and more number of fractures were seen in veneers prepared on maxillary incisors. [18]

Regarding the depth of the preparations, standardized labial reduction was done (0.3mm reduction at the cervical third and 0.5mm at the middle and incisal thirds), to ensure the whole preparation confined into enamel. This allows better bonding, higher strength, less leakage and excellent color matching without overcontouring.[19,20,21]

Patients today demand much more from their dentists and laboratory ceramists.[22] As a result, highly esthetic restorations and minimal-to-no-preparation restorations are no longer mutually exclusive. Therefore, dental professionals must consistently find a way to select treatment options that focus on the patient's best interest. With this in mind, a recent resurgence in the use of conventional feldspathic porcelain veneers has developed.[23]

With increased patient demands for enhanced esthetics and a need for restorative materials that closely mimic the patient's natural dentition, feldspathic porcelain represents the

premier esthetic material for custom restorations that are conservative and predictable for appropriate indications. Based on its high esthetic value and little-to-no preparation requirements, feldspathic porcelain enables dentists and their ceramists to provide esthetic treatments that are much less invasive, which is precisely what patients expect.[24]

The traditional proximal veneer preparation design extends to the interproximal stopping facial to the contact, this traditional preparation outline allows a simple, quick, and conservative reduction of tooth structure. Because all prepared surfaces are in enamel and contacts are left undisturbed, the traditional veneer preparation also precludes the need for temporization. Because of the relative ease of the preparation and the lack of temporaries, these "ideal" guidelines of veneer preparation have become almost universally acccptcd.[25,26]

But in many situations include maligned teeth, diastema closure, discoloration or staining, black space closure, replacing restorations and veneers adjacent to crowns, we find ourselves forced to extend the interproximal contact area, that's why we decided to make this study to evaluate the effect of varying interproximal extensions of feldspathic veneers on their fracture resistance.[26]

The orthognathic inter-incisal angle is 135 degrees. The effect of horizontal component of incising force can be studied by applying force palatally. But since the shear forces and compressive forces are maximum under the vertical component of incising force, in this study a vertical load application was preferred.[27,28]

Although it is expected to increase the retention and fracture resistance of the porcelain veneers with the increase of the preparation size as in the second group where the teeth prepared with extension (PCA), we found through the results of this study that the fracture resistance of feldspathic veneers without extension (PCA) in the first group higher than the fracture resistance in the second group. The reason may be due to the porcelain structure and distribution efforts in disto-mesiolabioincisal points angles.

Tai-Min Lin *et al*. found that the most favorable combination was a traditional veneer preparation design with conventional sintered feldspathic porcelain.[29]

Chander *et al.* found that stress levels increase on the incisal edge with an increase in extension of the PLV(porcelain laminate veneer).[30]

From a previous study, average masticatory forces ranging from 20 to 160 N were measured in the anterior teeth.[29] The mean value of the fracture resistance in the present study was for the first group is (914.0675 N) and

(727.9650 N) for the second group ,higher than the average masticatory force, and Therefore; the present result provides clinically relevant results.

The universal testing instrument (Test 114) was used to test fracture strength in this study. However, static in vitro testing provides limited knowledge about the long-term material properties of the veneer under fatiguing stresses.

CONCLUSION:

Within the limitations of this study, The fracture resistance force of feldspathic veneers without extension the proximal contact area is higher than the fracture resistance of feldspathic veneers with extension the proximal contact area. (The increase in extension increases the fracture potential of the feldspathic veneers)

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TABLES AND FIGURES:

Group	N	Mean	Std. Deviation	Std. Error Mean	t	P-value
Group 1 : porcelain veneers without extension the proximal contact area.	20	914.0675	289.70987	64.78110	2.175	*0.036
Group 2 : porcelain veneers with extension the proximal contact area.	20	727.9650	249.86694	55.87195		

Table 1: presents the fracture resistance force means, Std. Deviation, Std. Error Mean, t value, and P-value for the two groups.

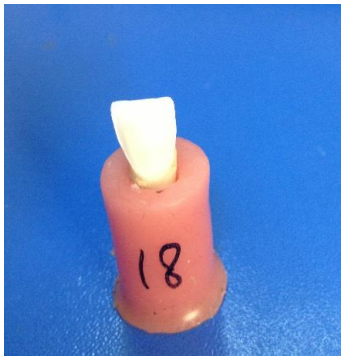

Figure 1: The preparation without extension the proximal contact area.

Figure 2: The preparation with extension the proximal contact area.

Figure 3: The two lead foils that had been used to uniform the preparation size in the sample.

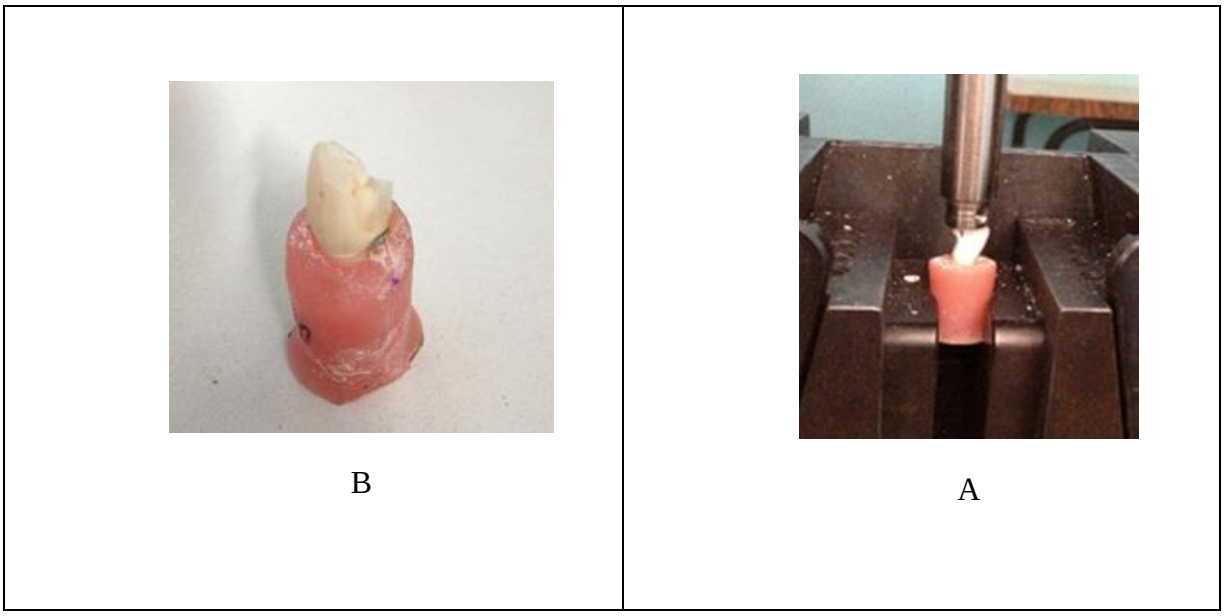

Figure 4: A. The vertical force that directed to the incisal edge of the veneer, B. The fracture after force had been applied.

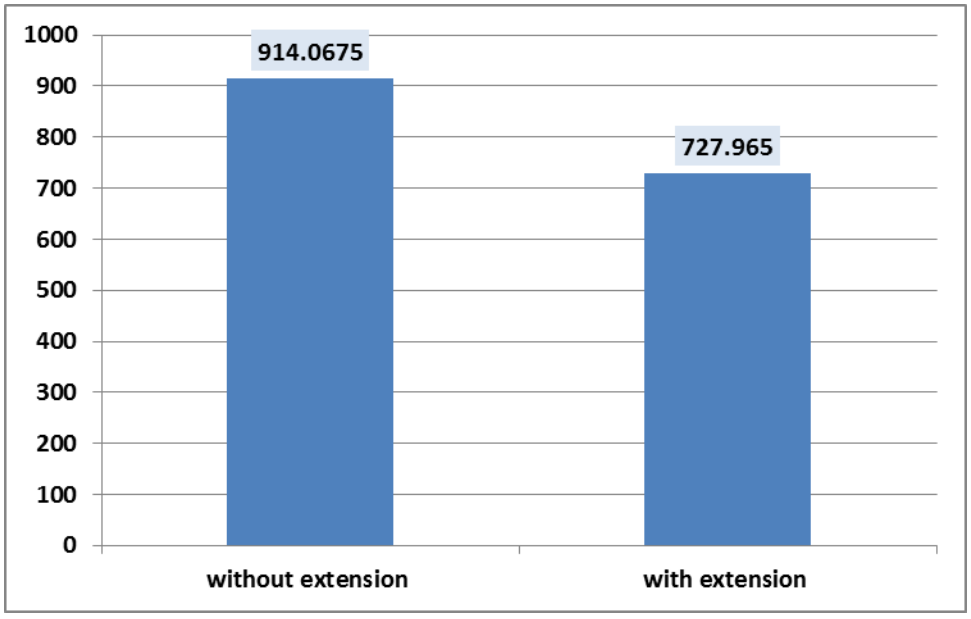

Figure 5: Presents the mean fracture resistance force in N for both groups.