

Porcelain laminates: the Future of Esthetic Dentistry

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Abstract: Porcelain laminate veneers are among the most esthetic means of creating a more pleasing and beautiful smile. Porcelain veneers within reason allow for the alteration of tooth position, shape, size and color. They require a minimal amount of tooth preparation, approximately 0.5 mm to 0.7mm of surface enamel reduction. This study describes the use of ceramic veneers without tooth wear, reinforcing the concept that minimally invasive porcelain laminate veneers could become versatile and conservative allies in the field of esthetic dentistry.

Keywords: Ceramics, dentin-bonding agents, esthetics.

I. Introduction

Smile has been evidenced as early as 300 BC. A smile on the face of statue of King of Arab is noted in the act of Summer. The dento-labial smile, where teeth are seen behind the lips started to emerge in the first decade of the 20th century. From that time on teeth began to play an important role in the face both in statues and portraits. The resulting emphasis on dental esthetics resulted in the emergence of laminate veneers.[1]

Laminate veneers were fabricated as early as 1930's by Pincus. He used the 'used air fired' porcelain for the same. By 1955 Bunocore's research into acid etching and the introduction of Bowen's resin Bis- GMA in the year 1960 resulted in the usage of composite as a veneering material. It had the drawback of reduced working time, lack of wear resistance and delamination. In 1975 with the advent of etching porcelain by Rochette, porcelain became the material of choice for laminate veneers[2,3].

Porcelain laminate veneers are among the most esthetic means of creating a more pleasing and beautiful smile. Porcelain veneers within reason allow for the alteration of tooth position, shape, size and color. They require a minimal amount of tooth preparation, approximately 0.5 mm to 0.7mm of surface enamel reduction. Therefore it is considered as more conservative restoration than a crown, which requires significant removal of sound tooth structure [1,2]. Although not the only alternative for all esthetic abnormalities, they are truly a remarkable restoration when they are the treatment of choice.[4]



Figure1; Pre-op post orthodontic treatment:

Porcelain veneers, alternatively termed dental veneers or dental porcelain laminates, are wafer-thin shells of porcelain that are bonded onto the facial surface of teeth so as to create a cosmetic improvement for a tooth.[1,4] Porcelain veneer technique utilizes the bonding capability of these materials to securely attach a thin shell of porcelain (the porcelain veneer) to a tooth. Although porcelain is inherently brittle, when it is firmly bonded to a tooth, it becomes very strong and durable.[3,5]

The ceramic laminate veneer remains the prosthetic restoration that best compiles the principles of present-day esthetic dentistry. It is kind to the soft tissue and adjoining periodontium. [6] It avoids the use of any metal structures and thereby possesses excellent esthetic quality. It is also the most conservative restoration, which preserves a significant proportion of the natural enamel. This "substitute enamel" now brings us closer to achieving the goals of prosthodontics; to replace human enamel to its proper structure, shape and color with this "bonded artificial enamel".[1,7,8,9,]

Initially four types of preparation were described for porcelain laminate veneers; only two of which required the incisal edge to be prepared.[10] Currently it is accepted however that when teeth are prepared for porcelain laminate veneers the incisal edge should be reduced by 1.0 mm and finished with a bevel or

overlapped onto the palatal surface.[11] The requirement to reduce the incisal edge has recently been questioned in two studies, which reported equivalent longevity for porcelain laminate veneers with and without incisal overlap.[12,13] It is suggested however that until further evidence is forthcoming the incisal edge be reduced when teeth are prepared for porcelain laminate veneers.[11] Two studies have reported a tendency for practitioners to under prepare teeth for porcelain laminate veneers with under preparation of the middle incisal third of the tooth being especially common. [4,6]



Figure2; Tooth preparation for Porcelain Veneers

Indications

1. Discolored teeth
2. Fractured teeth
3. Diastema closure
4. Slight malposition
5. Crown height increasing[3,6]

Contraindications

1. Teeth with insufficient or inadequate enamel for sufficient retention
2. Severe crowding
3. Parafunctional habits like Bruxism, clenching
4. Large Class-IV defects should not be restored with veneers because of the large amount of unsupported porcelain and the lack of tooth-colored backing.[3,6]

Advantages

1. It is very conservative in preparation. Enamel reduction of 0.5 mm or less is enough
2. Excellent esthetics: Porcelain veneers create a life-like tooth appearance
3. Excellent Biocompatibility: Tissue tolerance is excellent because of the highly glazed porcelain surface which provides less plaque accumulation
4. Porcelain veneers resist staining
5. Though the porcelain veneer is fragile, it is strong when bonded to tooth
6. The bond of the etched porcelain veneer to the enamel surface is considerably stronger than any other veneering system [4,6]

Disadvantages 6,10,13

1. The placing of veneers is technique sensitive
2. The veneers cannot be repaired once they are luted to the enamel
3. It is difficult to modify color once the veneers are luted in position on the enamel surface
4. Fragile veneer can break: Although strong when bonded to tooth, porcelain veneers are extremely fragile during try-in & cementation stages
5. Inability to trial-cement the restorations: They cannot be temporarily retained with a provisional cement for evaluation purposes
6. Expensive [4,6]



Figure 3: Prep shade , Gingival retraction cord

The dentists have a responsibility to produce harmonious smile without affecting the function of the oro-facial complex. Needless to say any procedure for the same should be as conservative as possible. The key to successful treatment lies in the harmony of the oral region of the face and eeth. The veneers are the recent trend in this direction. This review gives an insight about the evolution, indications, contraindications, advantages, and disadvantages of the laminates, as an effective esthetic restoration.

Veneer Preparation

Tooth preparation for veneer fabrication involves two stages;

- A. Shade selection
- B. Tooth preparation
- A. Shade selection

Shade selection is an important step in veneer preparation. Correct shade selection is vital to the success of the veneer. **Figure 1**[3,4,6]Shade selection is to be done prior to the preparation of the veneers. The various factors which affect the shade selection are as follows:-

1. Lighting of the operators room Colour corrected light and natural daylight are preferred to other sources of light in shade selection.
 2. Shade selection should not be done on dried tooth since the tooth appears whiter when dried. Isolation with cotton rolls and rubber dam also should be avoided while shade selection.
 3. Colour acuity and colour fatigue resulting from staring at an object for long duration results in wrong interpretation of colour.
 4. Stains and plaque on surface of tooth should be removed prior to shade selection.
- B. Tooth preparation

Cardinal rules for preparation:

1. The preparation should be as conservative as possible.
2. The preparation should allow for covering of 0.3mm to 0.5mm of veneer material without giving the tooth an overly thick appearance.
3. The preparation should not penetrate the dentin.
4. The preparation should allow for cleansable gingival margin.
5. The preparation should not include sharp angles.
6. The preparation should have a path of insertion which is free from undercuts.
7. Adequate clearance should be present interproximally.
8. Definite finish line should be prepared for accurate placement.

The principles which enhance tooth preparation are of three types[3,4,6];

1. Tooth surface :- Graded tooth preparation rests on the principle that more the colour change greater the amount of tooth reduction. Two levels of graded tooth preparation are necessary to create space- one level for moderate colour change and another for profound colour change.
2. Resin interface space :- Resin interface space allows the resin to dilute the tooth discolourations. So greater the discolouration greater should be the resin interface space.
3. Veneer formulation :- The brand of porcelain to be used depends on the degree of discolouration.

In general, for a two shade colour change or less the porcelain of choice tends to be relatively translucent whereas for masking discolouration more opaque porcelain with characterization should be used. **Figure 2**

Rationale for enamel preparation

Enamel preparation is performed for the following reasons:-

- To provide for adequate space for porcelain material
- To remove convexities and provide for single path of insertion
- To provide space for adequate opaquing/luting agent
- To provide a definite seat for the laminate
- To prepare a receptive enamel surface for etching and bonding the laminate
- To facilitate sulcular margin placement in severely discoloured teeth



Figure 4: Temps: Bis-GMA temporary created from the diagnostic wax-up, using a PVS reduction index.

The criteria of tooth preparation depend on the case. The present concept of enamel reduction varies from no reduction to minimal reduction. The ‘no prep’ (lumineers) concept which became popular in 2010 became successful in cases with teeth having normal anatomy, proper alignment and no discolouration. This need not be the same in a tetracycline stained teeth where enamel reduction is mandatory to bring about the desired effect.[6]

The concept of superfine laminates Of 2010- 11 is also gaining popularity. This reduces the amount of enamel preparation drastically.[4]

Enamel reduction procedure

Labial preparation

The preparation of the buccal plane of the incisors (which are convex) needs to be addressed in three planes with incisal, middle third and cervical planes.

A careful labial reduction of tooth structures is carried out to provide a minimum of 0.3mm (feldspathic porcelain) or 0.6mm (Empress esthetic, e.max) preparation[4,6].

There are several methods of attaining the reduction required with the preparation:

1. Freehand;
2. Use of depth cuts/grooves. The use of depth cutters or grooves and dimples has been recommended to control tooth preparation, as the use of standardised objects allows accurate judgement of depth; or
3. Use of silicone putty index.

Using a silicone index may help in assessing the amount of tissue reduction and can be prepared by the dental ceramist from the initial wax-up model. When viewed from the occlusal view, this can be cut in horizontal slices which can be peeled back to

assess different vertical positions of the reduced teeth .Utilisation of a silicone index derived from the wax-up allows a visualisation of the reduction required to achieve the form and contours of the pre-planned shape and length of the final veneers.[7,8,9,10] **Figure 3**



Figure 5 : Enamel etched on tooth

Proximal preparation

This preparation in the interproximal region can be made either by stopping short of breaking the contact, or by preparing through the contact point. 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. With the additional space inter-proximally, this allows the ceramist freedom to adjust the contours and position of the teeth.[11,12,13]



Figure6 : All veneers luted.

Incisal edge reduction

Different preparation designs have been advocated from feather and window preparations that involve no reduction of the incisal edge or preparation of the lingual surfaces, to other preparations that involve a reduction of the incisal edges. The author prefers an incisal preparation that is carried over the incisal edge from buccal to palatal, with up to 1.5 mm of incisal reduction.[14,15,16]

According to Calamia, a tooth preparation that incorporates incisal overlap is preferable, because the veneer is stronger and provides a positive seat during cementation. [11]This preparation design has the advantage of simple tooth preparation and the aesthetic characteristics are easier to fabricate with the ceramist, as it is possible to develop incisal translucency. The margin is not in a position where it will be subjected to protrusive forces and the preparation is reported to reduce stress concentration within the veneer by distributing the occlusal load over a wider surface.[17,18,19]



Figure7 : Veneers luted on sector I.

Sulcular extension and marginal placement

The cervical preparation for a veneer is recommended to be a chamfer design with a maximum depth of 0.4mm. This allows the veneer to reproduce natural tooth contours and not be over-contoured.[20] Additionally, it allows simple seating of the veneer and minimises stresses, enhancing the future fracture resistance of the veneer. Unlike crown margins that are often buried in the sulcus, the use of the thin translucent porcelain allows often a “contact lens” effect where the margins are blended with no discernible demarcation. This enables margins to be either equi-gingival or supra-gingival. Additionally there is a greater possibility that the margins will be in enamel. This ”contact lens effect” may extend the longevity of the veneer, with the apical migration of gingival margins not revealing a distinct line of demarcation between the veneer and the natural tooth.

A supra-gingival margin has many advantages with less risk of exposing dentine and less chance of injury to the soft tissues during preparation. Impression taking is also easier with no need for retraction and the likelihood of a clear margin captured. Due to the likelihood of the margin being in enamel, there is less chance of microleakage associated with enamel bonding. Subgingival margins may be required when there are caries or previous restorations extending sub-gingivally.[21,22,23,24]



Figure 8 : Immediate postoperative

Facebow Transfer and Bite Registration

To communicate clearly to the dental technician the correct final orientation of the incisal plane of the planned veneers, it is important that they receive a “stick bite” or “symmetry bite”. This can be as simple as two sticks within the bite registration to register the midline and the inter-pupillary line to the teeth[23]. **Figure 4**

Temporization

Some clinicians feel that provisionalisation is not necessary with veneers due to the minimal tooth reduction required. On the contrary, some others think that temporization is an integral part of the treatment process, especially considering that provisionals (if taken from the diagnostic wax-up) give the patient a preview of the final result.[3] **Figure 5**



Figure9: Immediate postoperative

Bonding veneers

The application of rubber dam is recommended to achieve adequate isolation, which helps to provide a clean, dry environment and minimizes contamination from saliva and blood . **Figure 6**[4]Light curing composite resin is preferred for cementation of the veneers as they have a longer working time than dual cure or chemically cured composites. This allows sufficient time to remove excess composite prior to curing and thus reduces the finishing procedures. The colour stability of light curing resin cements are much better compared to dual or chemical cure composites.[6]

Dual cure resin cements contain tertiary amines which may undergo long term colour change (“amine discolouration”) with overall darkening and thus are normally contraindicated with veneers due to their thin nature and translucency.[3] The use of various coloured resin cements has an influence on the final result attained and is often used to fine tune the final shade of the restoration to attain the desired outcome. Its influence is minimal, contributing less than 10% of the final colour of the restoration, however maybe useful to fine tune the final aesthetics[3,4]. **Figure 7**





Fig10 : Final Laminates Prosthesis after 2 weeks

Finishing and polishing If the bonding procedure was completed smoothly with a well fitting veneer, there should be very little cement to clean up from around the margins. It is preferred to not use a rotary instrument to finish the margins, as this may remove the glaze layer, increasing the roughness of the porcelain and causing increased plaque retention. The use of a #11,12 blade to carefully remove excess cement is a preferred technique, however at times if necessary a fine diamond can be used to adjust the porcelain and then carefully polished.[4,6] **Figure 8.9**

Occlusion is carefully checked initially with centric occlusion followed by other excursive movements. The use of rugby-shaped diamonds with water spray can be used to adjust the porcelain. Any adjustments must be further polished.[3]

II. Discussion

Porcelain veneers have been shown to be a good conservative and aesthetic treatment option. However they do have limitations and it has been shown that lack of enamel is one of the main causes of failure. Before treating a patient with porcelain veneers, the favourability of the environment should be assessed. If this is not favourable and margins will be on dentine or if excessive enamel will need to be removed, then alternative/adjunctive treatment options should be considered eg orthodontics and or periodontics. **Figure 10**

Diagnostic wax-up mock-up techniques are great tools during clinical evaluation and treatment planning, once they provide information on the possibility of using porcelain laminate veneers with minimal or no dental wear. That said, establishing a treatment plan using diagnostic wax-ups is utterly necessary to determine the exact final position and anatomy of the veneer. This preview is the safest way to evaluate the real need to perform dental wear.



Fig11 : Final Laminates, Immediate esthetical result

It is important to follow correct treatment protocols and strive for clinical and laboratory composite thickness ratio of above 3:1. When this ratio is large, the forces created by the polymerization shrinkage of the luting cement may cause fracture of the thin porcelain veneer. Post bonding cracks are an acknowledged, albeit rare, complication of porcelain veneers.[1,6,7,9] Based on literature it appears that if the veneer precision. This ensures minimal damage to tooth and gingivae and ensures optimal long term prognosis. Despite following all precautions, because of the delicate nature of porcelain veneers, a possible post-operative complication is cracking. If the veneer has been well bonded to the underlying enamel and is not an aesthetic concern, the patient should be informed and the veneer should be left in place.[3,7,8,14,15] Tooth veneering is a minimally invasive procedure that enables the practitioner to apply biomimetic principles in cosmetic dentistry, finding a balance between ceramic and enamel. The great majority of restorative procedures violates the balance between enamel and dentin in natural teeth. Unlike these procedures, the use of porcelain laminate veneers offers an excellent combination of hardness, resistance, and resilience.[15,16] According with Magne and Belser, a tooth restored with a porcelain laminate veneer that is subjected to posterior-anterior force recovers 89 to 96% of its coronary stiffness when compared with a healthy tooth.[22] Clinical factors such as remnant/substrate color, laminate thickness and luting system are known to potentially interfere with the final esthetic result. That said, the professional may resort to clinical interventions prior to optimizing esthetic results, as well as promote the use of minimally invasive or conservative techniques. Conversely, the following variables have been associated with optimal and predictable results: dental/remnant bleaching prior to veneer application, use of opaque ceramic systems, careful selection of the most appropriate luting system and of adequate shades/colors,

try-in stage using appropriate pastes, use of hydrosoluble gel or water prior to final luting with composite cements.[23] The minimally invasive, conservative porcelain laminate veneer technique here described is an extremely versatile clinical procedure, with excellent esthetic results when performed according to a well-designed treatment plan and a strict protocol during the clinical and laboratory stages[4,6,23]. The survival probability of porcelain veneers according to the Kaplan - Meier survival estimation method was 97% at 5 years and 91% at 10½ years. The failure rate significantly increased when the finish line crossed an existing filling, while no influence was found for the type of preparation of incisal edge, the location of gingival **Figure11** In another study done in 2012, it was found that the survival rate to be 94.4% at 5 years, 93.5% at 10 years and 82.93% at 20 years.[17] The maximum number of failures found by these authors was a ceramic fracture. People with parafunctional habit especially bruxism and discoloration at the margins in smokers showed more failures. Yet another study reported 97.5% survival rate at 7 years.[25,26,27]

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III. Conclusion

The porcelain veneer is very esthetic and conservative treatment option for many indications. The success of porcelain veneer depends very much on the method of fabrication and most importantly case selection. The research in this field has been based on personal preference and anecdotal information, more objective research is required so that porcelain veneer will become better successful.

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