

PORCELAIN LAMINATES- CURRENT STATE OF THE ART: A CLINICAL REVIEW

Muhamad Abu-Hussein¹, Nezar Watted², Azzaldeen Abdulgani³

1. University of Naples Federic II, Naples, Italy, Department of Pediatric Dentistry, University of Athens, Athens, Greece.

2. Department of Orthodontics, Arab American University, Jenin, Palestine

3. Department of Conservative Dentistry, Al-Quds University, Jerusalem, Palestine

ABSTRACT:

Very minimal preparation with enamel preservation offer best results in esthetic dentistry. Composite restoration offer repairable option for a smile treatment plan. Sometimes, it may be preferable to extend the veneer preparations beyond the contact points toward the palatal surface, to hide the margins of the restoration.

The use of porcelain laminate veneers to solve esthetic and/or functional problems has shown to be a valid treatment option especially in the anterior esthetic zone. The techniques and the materials employed to fabricate porcelain laminate veneers offer satisfactory, predictable and lasting results. The current porcelain veneers are esthetically superior, conservative and durable treatment modality. This review gives an insight about the evolution, indications, contraindications, advantages, and disadvantages of the laminates, as an effective esthetic restoration.

Keywords: Porcelain, Veneers, Esthetics, Laminates



INTRODUCTION:

In the aesthetic dentistry, the porcelain veneers present the first class clinical conservative modalities. The current literature recognizes them as the state of the art of each auspicious dental practice^[1]. As being less invasive, for both hard and soft tissues and granting satisfactory aesthetic outcome, the rehabilitation procedure with porcelain veneers has been widely welcomed by the patients. In addition, the modern improvement of composite cements, adhesive systems and simplified cementation procedures also enable the promotion of this effective treatment approach among the dentists.^[2,3]

Porcelain Laminate Veneer: A thin bonded ceramic restoration that restores the facial surface and part of the proximal surfaces of teeth requiring esthetic restoration.^[1]

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

*Corresponding Author Address: Dr. Azzaldeen Abdulgani, Department of Conservative Dentistry, Al-Quds University, Jerusalem, Palestine. Email: azzaldeenabdulgani@gmail.com

firmly bonded to a tooth, it becomes very strong and durable.^[3,5]

Porcelain laminate veneers (PLV) were introduced into dentistry as Hollywood veneers by Pincus(1938) . With the introduction of acid etch technique by Buonocore (1955) interest was generated in PLV. Coupled with silanization of veneers and the introduction of bonded porcelain veneer by Horn (1983) the results with PLV have become more predictable. Survival rates have ranged from 92% at 5 years to 64 % at 10 years . Carefully placed PLV have reported very high survival rates of over 91% after 10 years stressing the need for the proper case selection and technique.^[1,3,5,6]

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. It avoids the use of any metal structures and there by 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”.^[1,7,8,9,10,11,12]

This review gives an insight about the evolution, indications, contraindications, advantages, and disadvantages of the laminates, as an effective esthetic restoration.

INDICATIONS ^[3,6,8]

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

CONTRAINDICATIONS ^[3,6,8]

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.

ADVANTAGES ^[6,10,13]

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

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



Figure1a ;Pre-op smile

Success of porcelain veneers depends on both clinical and lab procedures. Case selection and tooth preparation as required by the situation, shade selection, proper material selection and lab procedures, etching technique and good bonding materials can make the porcelain veneer last long with best appearance. Figure 1a-b



Figure1b ;Pre-op smile



Figure2 ;colour and surface texture of the teeth

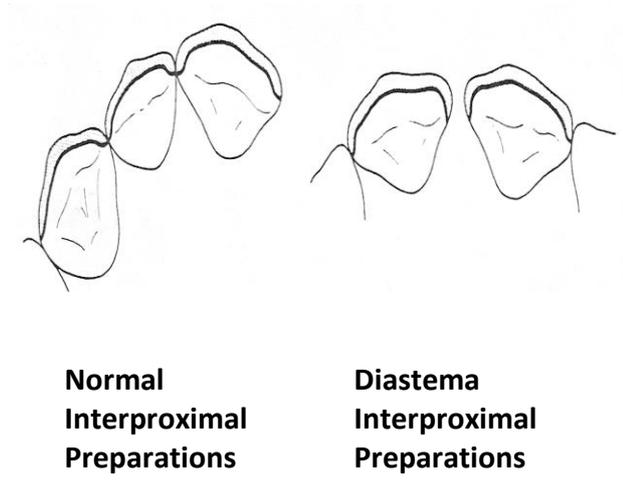
TOOTH PREPARATION [5,14]

I. **Labial reduction:** The optimal reduction of ging $\frac{1}{2}$ of labial surface is 0.3mm and for incisal $\frac{1}{2}$ is 0.5mm.

Using diamond depth cutter, depth orientation grooves of 0.3mm in ging $\frac{1}{2}$ &

0.5mm in incisal ½ of labial surface are placed. The tooth structure remaining between the depth orientation is removed with round-end tapered diamond while the tip of round-end diamond establishes a slight chamfer finish line at the level of gingiva. The margin should follow the gingival crest so that all discolored enamel will be removed.

II. Interproximal extension: The laminate preparation must be extended into the embrasure areas to ensure that the margin between the veneer and the unprepared tooth structure is hidden. This right-angled extension to the labial surface improves the strength and adhesion of the veneer. The proximal reduction should extend into contact area, but it should stop just short of breaking the contact.



Normal Interproximal Preparations

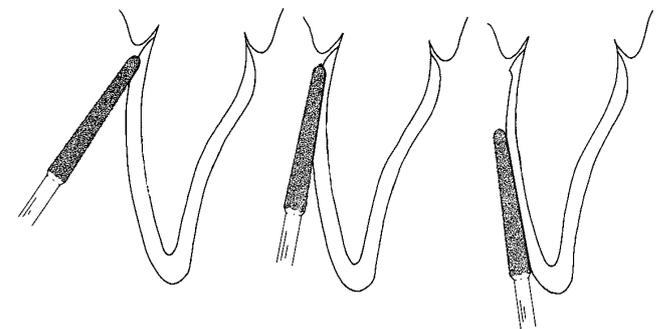
Diastema Interproximal Preparations

III. Incisal reduction: There are two techniques for placement of incisal finish

line.



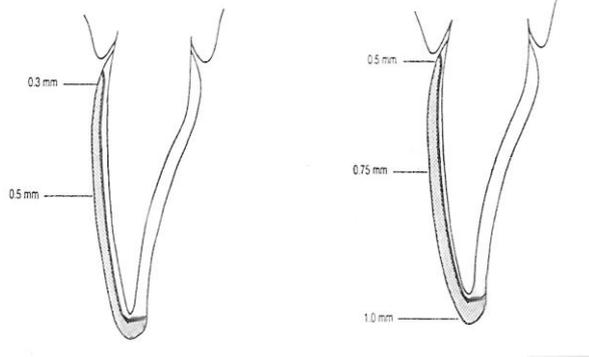
Figure3 ;Final preparations with single retraction cord ready for final impression



- 1). The prepared facial surface is terminated at incisal edge.
- 2). The incisal edge is slightly reduced & the finish line terminates on lingual surface.

If possible, do not reduce the incisal edge, this helps support the porcelain & makes chipping less likely. Figure2-3

If incisal edge length is to be increased, the preparation should extend to the lingual



Minor Color Change

Major Color Change

Impressions

1. Use retraction cord if desired. May not be necessary with minor shade change.
2. Make a full-arch impression with an accurate and stable polyvinylsiloxane or polyether impression material.
3. Make a stable bite registration.

Temporization techniques

1. Minimal shade change veneers may not need temporization if the shape is unchanged.
2. Individual direct composite resin veneers:
 - a. "Spot-etch" enamel.
 - b. Use unfilled resin only, not a 4th, 5th, 6th or 7th generation bonding agent.
 - c. Apply and contour resin veneers using "free-hand" technique.
3. Multi-unit composite resin veneers: (Not removed from teeth for polishing)
 - a. Make a polyvinyl impression using a clear impression material such as RSVP

(Cosmedent) in a clear non-retentive tray of your diagnostic model.

- b. Cover all gingival margins. Once set, remove from model and tray.
- c. Trim the lingual polyvinyl impression to just cover the lingual margins approximately 1mm. Trim the facial portion just incisal to the papilla
- d. Spot-etch each prepared tooth for added retention. This is not necessary if there is adequate mechanical retention.
- e. Place unfilled resin on the teeth and light cure. (Only unfilled resin, no dentin bonding agents.)
 - f. Load matrix with appropriate shade of incisal RSVP composite material.
 - g. Apply composite-filled matrix to prepared teeth.
 - h. Remove excess composite resin on facial and lingual with instruments.
 - i. Light-cure the composite for 3 seconds on each tooth.
 - h. Peel matrix from cured composite and trim excess prior to final cure.
 - i. Light cure each tooth for 20 seconds.
 - j. Freehand the gingival half and margins with RSVP cervical composite and light cure.

k. Finish and polish as needed with finishing burs, discs, points, and cups without damaging preparation. A glaze, such as Temp Glaze or Biscover may be used.

Laboratory communication:

1. Take digital photograph of prepared teeth for veneers with shade guide of desired veneer shade next to teeth.

2. Select an opacity level. Opaqueing should be in the veneer as much as possible.

3. Tell laboratory the desired shade of the finished veneers. Also, describe the shade of prepared teeth and diagram any localized discolored areas. Whenever possible, have laboratory use translucent porcelain in the cervical area to provide a nice blend with the enamel (“contact lens effect”). Subopaqueing of preparations with composite may be necessary for tetracycline teeth.

4. Send digital pre-op and post-preparation with shade tab photographs.

5. Send model of provisionals for lab to replicate.

6. Specify veneer length and location of finish line (e.g., wrap incisal).

7. Describe desired surface anatomy--smooth, moderate, heavy.

8. Although location of proximal finish line should be obvious, some labs want the dentist to tell whether these are labial, proximal, or lingual. (Lingual finish lines are indicated for diastema closures.)

9. If major contour changes are desired, send ideal waxed up model.

10. Keep instructions as simple as possible.

Veneer try-in:

1. Place retraction cord if needed.

2. Pumice the teeth. Use floss or sandpaper strips to clean interproximally. Avoid tissue trauma.

3. Try in each veneer dry. Check the fit, marginal integrity, etc.

4. Try in all veneers together with water or glycerin to check overall fit and appearance. Adjust contacts as needed with a fine diamond.

5. Try in one or two veneers with try-in paste or resin cement:

a. Water-soluble try-in pastes are easier to use than the actual cements.

b. Check masking of discoloration and approximation of desired final appearance. (Resin shade will change slightly with curing.)

c. Work quickly; light will set some of these resins rather rapidly. (Turn operator light off during try-in and cementation.)

d. The porcelain veneer should provide most of the color. Use of tints, opaquers, or resin combinations is risky business for most operators.

e. Clean resin out of the veneers with acetone. Remove any excess resin from the teeth with cotton pellets, floss, etc.

6. Clean each veneer by applying phosphoric acid for 10-15 seconds. Rinse thoroughly.
Figure 4-5



Figure 4: Final veneers. Note detailed, natural morphology, texture and characterisation

Silanation:

Ideal Way

- a. Have the laboratory return the veneers unetched and unsilanated. They may be sand blasted with glass beads.
- b. Try veneers on the model for fit.
- c. Try veneers in the mouth with glycerine or try-in paste.
- d. Clean in ultra sonic with acetone.
- e. Etch inside of veneers with Hydrofluoric acid per manufacturers instructions.
- f. Apply 1-2 coats of a 2 part silane that was just mixed.
- g. Seat the veneers.

Practical Way - A

- a. Have the laboratory sand blast and hydrofluoric acid etch the veneers.
- b. Have the laboratory silanate the veneers
- c. Try on model
- d. Try in mouth
- e. Clean in ultra sonic with acetone.
- f. Seat the veneers

Practical Way - B

- a. Have the laboratory sand blast and hydrofluoric acid etch the veneers.
- b. The dentist should silanate the veneers.
- c. Try on the model
- d. Try in the mouth
- e. Clean in ultra sonic with acetone
- f. Seat the veneers.



Figure 5: Final veneers. Note detailed morphology, texture and characterisation

CEMENTATION PROCEDURE [3,6]

1. Check for fit of veneer: A drop of water or glycerine will help the veneer stay in place during try-in.
 2. Check for color / shade: The final appearance of veneer is affected by shade of cement used. The actual composite resin cement is placed & trial checked. The un-cured composite cement is removed by application of acetone or alcohol.
 3. Ceramic veneers should be etched, silaned and bonded to underlying enamel with selected shade of dual-cured composite resin cement.
 4. The ceramic veneers are etched for 1min with 5% hydrofluoric acid solution.
 5. The etched surface is then treated with silane coupling agent that chemically bonds the restoration to the resin cement
 6. The tooth is then etched with 37% phosphoric acid for 15-20 sec, followed by rinsing with water for 30 sec & drying with air.
 7. A layer of bonding agent is cured to the etched enamel
 8. The selected color of luting composite is coated onto the laminate veneer & seated with finger pressure.
 9. Excess cement is removed, & curing is done for 1min with curing light.
- Figure6

Recall:

1. Recall the patient in one month or less to evaluate porcelain veneers.
2. Check and adjust occlusion as necessary.
3. Remove any excess resin cement that was not detected at cementation.
4. Adjust contours of veneers if necessary.
5. At subsequent recall appointments...
 - a. Use curettes rather than scalers around veneers.
 - b. Use composite polishing paste (Enamelize, Cosmedent) instead of conventional prophylaxis paste.
 - c. Use neutral NaF gel, not APF (which etches porcelain).

DISCUSSION:

The introduction of new dental technology combined with changing patients attitude, is slowly altering dentistry's approach to esthetic problems^[1,15].

The patients acceptance of the porcelain laminate veneer technique now-a-days seems to be high. A study conducted by Goldstein and Lancaster ^[7] showed that patients would readily accept shorter restoration life expectancy (five to eight years) if enamel could be saved by not reducing the tooth for a full crown.^[16]

The technique is expected in the near future to be drastically simplified. Clinical researches to date has shown excellent retention rates. The introduction of high strength dentin bonding agents and reliable

resin cements will accelerate the progression towards bonded porcelain used in clinical practice .^[17,18]

On the other hand long-term study of porcelain veneers is required in order to study their marginal integrity, marginal staining and their effect on gingival tissues.



Figure 6: Final veneers bonded in place

Porcelain veneers are with best esthetic and mechanical properties and show low fracture degree. Unlike composite veneers they can not be repaired ^(1,3). Porcelain veneers do not change their color with time and have no leakage of water soluble dyes. Marginal adaptation and luting technique play an important role for the degree and time after which a marginal discoloration will appear⁽¹⁵⁾. Patient's hygiene is also of great importance. A serious disadvantage of porcelain veneers is their high price ⁽⁸⁾.

The preparation of the teeth greatly influences the durability and color (translucency and tonality) of the ceramic restoration, as the tooth preparation will determine the inner superficial contour and the thickness of the ceramic material. A veneer requires a minimum of 0.2 mm to

(ideally) 0.3 mm of thickness for each shade change. Ceramic translucency also plays an important role for light penetration.^[18,19]

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.^[16,17]

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 polymerisation 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.^[17,18,19]

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.^[20]

Patients with bruxism or tooth-to-foreign object contact may not be ideal candidates for veneers. In cases of minor incisal wear owing to bruxism, it is often possible to restore the incisal length using PLVs. It is very important to evaluate the occlusal scheme and manage the occlusal forces before any treatment with PLVs is attempted. In these cases, an occlusal guard is indicated to assist in the prevention of postoperative ceramic fracture.^[17,18,19]

Finally, we believe that the advantages of this technique as a treatment modality make it worthy of serious consideration in view of the distribution and prevalence of

certain dental problems confronting the general practitioner.

CONCLUSION:

Bonded porcelain veneers can provide successful esthetic and functional long-term service for the patients. Porcelain laminate veneers offers more extensive applications when they are used cautiously and the results achieved have been gratifying for the dentist and the patient alike. It has become increasingly apparent that conservation of tooth structure is a major factor in determining the long-term prognosis of any restorative procedure.

REFERENCES:

1. Academy of prosthodontics: The glossary of prosthodontic terms-8. *J Prosthet Dent* 2005; 94:54
2. Weinberg LA. Tooth preparation for porcelain laminates. *New York State Dental Journal* 1989;5:25–8.
3. Magne P, Hanna J, Magne M. The case for moderate, “guided prep” indirect porcelain veneers in the anterior dentition. The pendulum of porcelain veneer preparations: from almost no-prep to over-prep to noprep, *European Journal of Esthetic Dentistry* 2013;8(3):376-388.
4. Azer SS, Rosenstiel SF, Seghi RR, Johnston WM. Effect of substrate shades on the color of ceramic laminate veneers, *Journal of Prosthetic Dentistry* 2011; 106(3):179–183.
5. LeSage B. Establishing a classification system and criteria for veneer preparations, *Compendium of Continuing Education in Dentistry* 2013; 34(2):104–117.
6. Layton DM, Clarke M, Walton TR. A systematic review and meta-analysis of the survival of feldspathic porcelain veneers over 5 and 10 years, *The International journal of prosthodontics* 2012; 25(6):590–603.
7. Friedman MJ. A 15-year review of porcelain veneer failure – a clinician’s observation *Compend Contin EducDent* 1998; 19(6):625-8.
8. Dumfahrt H, Schäffer H: Porcelain laminate veneers. A retrospective evaluation after 1 to 10 years of service: Part II-Clinical results. *International Journal of Prosthodontics*, 2000;13(1):9-18.
9. Garber.D.A, Rational tooth preparation for porcelain laminate

- veneers. Compendium 1991 .May
12; 316-320
10. Garber.D.A, Goldstein.R.E,
Feinman.RA: Porcelain laminate
veneers; Quintessence Publishing
Co. 1988
 11. Goldstein R and Lancaster J: Survey
on patient attitude towards current
esthetic procedures. J. Prosth. Dent.,
1984;52: 775
 12. Horn HR: Porcelain laminate veneers
bonded to etched enamel. Dental
Clinics of North America, 1983;
27(4):671-684.
 13. Levin.R.P,: The future of Porcelain
Laminate Veneers.J. Esthet-
Dent,1989;Mar-Apr:45-6
 14. Miller.B.J. Porcelain veneers. Dent
Update, 1987;14; 381-385
 15. Gurel G. Predictable, precise, and
repeatable tooth preparation for
porcelain laminate veneers. Pract
Proced Aesthet Dent. 2003 Jan-
Feb;15(1):17-24; quiz 26.
 16. Faunce FR, Myers DR: Laminate
veneer restoration of permanent
incisors. J Am Dent Assoc
1976;93:790-792.
 17. Sheets CG, Taniguchi T: Advantages
and limitations in the use of
porcelain veneer restorations. The
Journal of Prosthetic Dentistry,
1990; 64(4):406-411.
 18. Simon R.J and Calamia J.R. Tensile
bond strength of etched porcelain.
J.Dent.Res 1983;62:297
 19. Weignberg LA: Tooth preparation
for porcelain laminates. NewYork J
of Dent.1989;55(5):25-8
 20. Walls Awg, Steele Jg & Wassell Rw,
Crowns And Extra Coronal
Restorations: Porcelain Laminate
Veneers,Bdj,Vol-193, No-2,July
27,2002,73-82