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Abstract

Veneers have been widely used and successful in dentistry for nearly 30 years. Despite their success, confusion regarding patient selection, indications, preparation design and material selection still exists. This course is designed to review techniques in preparation design, temporization and cementation of veneers, as well as patient selection. A case study is reviewed to demonstrate execution of these techniques. The three most popular ceramics for veneers are reviewed to aid the practitioner in selection of the most appropriate material per case.

Educational Objectives

At the end of this program participants will be able to:

- 1. Indicate proper case selection for veneers.
- 2. Understand smile design principles and goals.
- Understand preparation design and when no preparation is possible.
- Perform a "mock-up" and understand why it is a crucial step in the cosmetic/veneer process.
- Temporize veneers predictably and efficiently and understand their role in achieving the patient's goals.
- 6. Follow a simplified process in veneer cementation.
- Differentiate between feldspathic- and glass-based materials and their indications for use.

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Since their introduction in the '80s, veneers have been considered an excellent treatment modality for aesthetic dentistry due to their strength, longevity, conservative nature and biocompatibility. With a nearly 30-year history in dentistry, their success has been widely measured. 254-5 Currently they are one of the most predictable treatment modalities available in aesthetic dentistry. 23,85,867

The indications and usage of porcelain veneers have grown since their inception. Once utilized for discolorations in the dentition, porcelain veneers/restorations are now indicated in patients with malpositioned teeth, wear and erosion. Porcelain veneers, once contraindicated in patients with loss of vertical dimension, are now being widely used to restore these patients with extremely conservative restorations, due to the advancement in materials which are currently available. Diagnosis of the patient's current condition, and careful treatment planning will ensure a predictable outcome and long-term success.

Success and longevity of porcelain restorations have been shown to increase when bonded to enamel as opposed to dentin.

The dental literature, it is advised to be as conservative as possible when providing this type of treatment. It is currently possible to have restorations with a thickness of .3mm, in both minimal and noprep restorations.

Unfortunately over the years, the desire to remain conservative has seen dentists try to stretch "no-prep" restorations beyond their clinical indications.

Guidelines and case selection for minimal- to no-preparation veneers are as follows: proper pre-operative arch alignment required, color change, lengthening, closing small interproximal spaces, collapsed buccal corridor, wear (when knowledge of source is present) and replacement of direct resin bonding cases. Contraindications of no-preparation veneers are rotation or crowding, buccally displaced teeth, severely lingualized teeth, bell-shaped or flared teeth, severely discolored teeth in relatively normal arch form, and large interproximal spaces.

Guidelines for breaking contact in preparation design include: changing the mesial-distal width of teeth, moving proximal surfaces, resultant preparation contact is extremely thin and presence of interproximal restorations.

Feldspathic Veneers

"Feldspathic veneers are created by layering glass-based (silicon dioxide) powder and liquid materials." The technician uses a layering and firing process which allows him to "stack" the veneer with different shades and opacities to reflect the natural dentition. The benefit to the stacked procedure is that the ceramist has the ability to modify opacities within the same restoration. This is a benefit in cases such as those affected with tetracycline staining where the tooth may have a relative normal shade, except for a small dark band within a segment of tooth structure. A feldspathic restoration in this situation could have a relative translucent appearance in the areas not affected by the banding, and an opaque appearance to cover the area affected of the banding.

Feldspathic flexural strength is approximately 60 to 70MPa,¹¹ Because of weaker flexural strength of these restorations it is ideal to provide both high bond strengths, and stiff underlying tooth structure (enamel) to achieve success,¹² The ideal conditions for the bond between the veneer and the substrate are the presence of a rate of 50 percent or more of the enamel remaining on the tooth; 50 percent or more of the bonded substrate being enamel; and 70 percent or more of the margin being in enamel, ¹⁶1,8112

Glass-based Ceramics

Glass-based ceramics have some distinct advantages of feldspathic restorations including increased flexural strength, increased fracture resistance, improved thermal shock resistance and resistance to erosion. The increase in strength of the glass ceramic is achieved by adding fillers such as aluminum, magnesium, zirconia, leucite and lithium disilicate. Leucite (IPS Empress) and lithium disilicate (IPS e.max Press) are "fabricated through the lost wax and heat-pressed techniques." 6-19

"The microstructure is similar to that of powder porcelains; however, pressed ceramics are less porous and can have a higher crystalline content because the ingots are manufactured from nonporous glass ingots by applying a heat treatment that transforms some of the glass into crystals. This process can be expected to produce well-controlled and homogeneous materials." IPS e.max Press has a flexural strength of 400MPa in its

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monolithic form, while IPS empress has 160-185MPa monolithic. Once these materials are cut back and layered they both exhibit approximately 150-180MPa in the layered areas.

Smile Design

The process of smile design (Fig. 1) includes gathering information regarding the wide variables of a patient's smile. The three goals of smile design are 1) to obtain input from the patient regarding their desires 2) to transfer these desires to the ceramist and 3) to provide "ideal" aesthetics based upon the subjective criteria that meet the patient's goals.14

Typically the initial starting point in the smile design process is the maxillary central incisor. Using traditional prosthodontic principles one can establish the proper length by utilizing several techniques.34

- 1) Display of tooth structure during rest position
- 2) Phonetics ("F" and "V" sound)
- 3) 75-80 percent width/height ratio
- 4) 22mm rule (incisal edge distance from muccobuccal fold)
- 5) Protrusive and laterotrusive concerns
- 6) Patient's desires

Case Presentation

A 27-year-old female (Figs. 2, 3, 4, 5) presented to the office with the desire for a more feminine and attractive smile. Her dental history included traditional orthodontic treatment between the ages of 14-16, and Invisalign treatment during the ages of 22-24. Both of these options seemingly have failed due to the arch size/tooth width discrepancy.

Clinically interproximal spaces are present between several of the undersized anterior teeth. The canines are slightly rotated facially, displaying the mesial interproximal embrasures and giv-





ing them a very prominent appearance in her smile. Due to the position of the canines, the premolars appear to be deficient in the buccal corridor.

A complete examination was performed, including a fullmouth series of radiographs, periodontal charting, occlusal analysis with T-scan III, and joint vibration analysis to verify the health of the temporomandibular joint. Upon the completion of the examination aesthetic options were discussed, including mock-up-assisted minimal-preparation veneers, as well as correction of slight gingival level discrepancies.

To communicate the desired length and position of her teeth for the final restorations, a mock-up was done by adding Accolade flowable composite to the incisal edges of the anterior six teeth using the previous prosthodontic principles discussed. To communicate the buccal corridor position, flowable composite was added to the facial of the premolars and molars.

Polyvinyl siloxane impressions were taken of the mock-up and of her teeth pre-operatively. A facebow transfer was completed using the Kois Dento-Facial Analyzer, and a centric relation bite was taken to communicate proper jaw position and facilitate mounting to the articulator. Pre-op photos were taken of the patient, of the mock-up and with shade tabs of her existing dentition.



Fig. 2: Headshot pre-op



Fig. 3: Pre-op 5mile 1:2





Fig. 4: Left lateral pre-op smile Fig. 5: Alght lateral pre-op smile

continued on page \$7

continuing education

feature percention page 91





Fig. 6: Diagnostic wax-up, reduction model and stent, siltech, final reduction guides

Fig. 7: Filling sittech with bisacryl

A diagnostic wax-up was completed to the previously chosen incisal edge position, width and facial position of the teeth. An enameloplasty model and stent (Fig. 6) were fabricated along with the diagnostic wax-up, siltech and final reduction stents (Gold Dust Dental Lab, Tempe, Arizona). The areas indicated with black marker on the reduction model indicate the areas of the enameloplasty that is required prior to transferring the diagnostic wax-up over the existing teeth (mock-up). Once the initial reduction has been performed (usually without anesthesia), the siltech is filled with Luxatemp bisacryl (Fig. 7) (DMG) and placed over the anterior 10 teeth (Fig. 8).

Transferring the diagnostic wax-up (mock-up) over the existing dentition allows the preparation process to occur from the final restorations desired position. This allows for the most conservative, uniform reduction while preventing over and under reduction to the existing dentition. Also, the transferred mock-up serves as a laser guide for the proper placement of the gingival zeniths (Fig. 9). Upon patient approval of the mock-up, anesthesia is given through traditional infiltration.

Once the correction of the gingival heights has been completed (Picasso, AMD lasers), initial reduction depth guides are placed with a .3mm reduction bur in the gingival, middle and incisal thirds of the teeth. Depending on the desired final shade, material selection and pre-operative preparation color will determine the ideal reduction depths to use. Proper case planning with your laboratory is crucial to ensure you and the patient can achieve the desired result. Incisal reduction is carried out utilizing a 1.5mm diamond (Fig. 10). Once this is complete, removal of the mock-up can be completed, and the preparations finished and polished.

Contact was broken between the maxillary anterior six teeth (slice preps) due to the interproximal spaces present with undercuts on the adjacent teeth, and the desire to change the mesial/distal width of the teeth. Interproximal elbow preparations were placed in the premolars, and the contacts preserved (Fig. 11), Each preparation should at least follow the papilla and extend to the proximal contact. (Eig. 12). This is an imporpreparation shade tabs and photos (Fig. 12). This is an impor-











Fig. 8: Seating bisacryl Fig. 9: Mock-up with laser Fig. 10: Mock-up with reduction Fig. 11: Preparation examples (not the same patient) Fig. 12: Final prep photo and shade tab



Fig. 14









Fig. 13: Super-floss picture with temps Fig. 14: Palatal Injection site

Fig. 14: Palatai injection site Fig. 15: Try in paste picture

Fig. 16: Tack and wave Fig. 17: Cement removal

tant communication tool that is required by the laboratory when selecting the correct ingot (pressed ceramics) or porcelain shades (feldspathic ceramics). Final VPS impressions are then taken.

Shrink Wrap Temporary Technique

1) Systemp Desensitizer (Ivoclar Vivadent) is placed over the existing preparations and then blotted dry. 2) Optibond Fl Primer (Kerr) is then placed on the existing preparations and air dried thoroughly. 3) The siltech is loaded with the desired shade of Luxatemp bisacryl (DMG) and let set for 1.5 minutes. The siltech is then teased off and the temporaries finished and polished by removing the excess with carbide finishing burs, and Astropol polishing points (Ivoclar Vivadent). The occlusion was verified, and final positions communicated with the patient. A final shade was determined. It is important to verify at this point in time that the patient can place either super-floss or floss-threaders interproximally below the contact points (Fig. 13) to maintain proper hygiene and ensure healthy gingival tissues at the cementation visit.

Impressions were taken of the temporaries to communicate size and shape with the lab, as well as initiate mounting of the models on an articulator. A facebow transfer was repeated, and bite records repeated. Photographs were taken of the temporaries for communication with the ceramist. The temporaries serve an extremely important task of the aesthetic "test drive" of the final restorations. The patient can communicate desired changes, if she sees fit, prior to fabrication of the final restorations. This is a process I utilize even with "no-prep" cases.

Tack and Wave Cementation

Anesthesia is given palatally (Fig. 14) on cementation visit so that the patient has full movement of her maxillary lip and has the ability to properly judge the final ceramics. The temporaries are removed by placing a hemostat interproximally and gently squeezing until they dislodge. Once all of the temporaries are removed, each veneer is tried in one at a time to ensure proper fit and marginal integrity. Once each veneer has been tried in and confirmed, they are then tried in all at the same time starting with the central incisors. Each contact is confirmed while ensuring the margins of each restoration fit the same as they did singularly. Tryin paste is then utilized (Variolink Veneer: Ivoclar Vivadent) to determine if a warmer or brighter look is desired (Fig. 15).

Once the patient approves the appearance of the veneers, they are removed and cleaned with Ivoclean (Ivoclar Vivadent)

continued on page Rd

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(providing they have already with hydrofluoric acid etched by the laboratory). Silane is placed for one minute per restoration then dried. Bonding agent is placed in the internal aspect of each restoration (Excite-F: Ivoclar Vivadent) followed by the desired cement shade (Variolink Veneer: Ivoclar Vivadent). These are placed under a protective box to prevent polymerization of the bonding agent and the cement.

A rubber damn is placed for isolation of the arch.
Consepsis scrub (Ultradent) is used and thoroughly rinsed to clean the preparations and remove any unwanted contaminants that might affect bond strengths. Then 35% phosphoric acid etch is placed on the teeth for 15 seconds, rinsed and dried (care should be taken not to desiccate the preparations). Systemp-D (Ivoclar Vivadent) is then placed over the preps and blot dried. Excite-F is placed on each restoration and polymerized for 10 seconds each. Starting with the central incisors, each veneer is placed until all 10 have been seated at the same time. Care should be taken to ensure that the veneers fit the same as they have during the try-in phase.

Starting with the centrals, a "tack" tip is placed on the curing light and each veneer is "tacked" to place by curing for approximately one or two seconds per tooth (Fig. 16). The tack tip is then replaced by a conventional light-cure tip, the light is turned on and "waved" over the 10 restorations for approximately two seconds front (total) and two seconds back (total). At this time the cement should be set to a gel-like consistency and allow for easy removal (Fig. 17). Complete cement removal should be completed with floss, scalers, etc. Once all excess cement has been removed, Liquid Strip (Ivoclar Vivadent) is placed over the margins and final polymerization is completed.

The occlusion was verified and adjustments made with the T-Scan III occlusal analysis system in all excursive movements, centric and the final polish was completed. The diagnostic waxup and mock-up transfer ensures your veneer/all-ceramic restorations will be performed as conservative as possible.
Minimally invasive dentistry can be a viable option whether you are attempting to rebuild a worn dentition to optimum function and anterior guidance or providing your patient with an outstanding smile. With both the doctor and lab having sound knowledge of guidelines, materials and case selection, your patient will be happy with the results for many years to come.

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Fig. 18: Post-op head shot



Fig. 19: Post-op smile 1:2





Fig. 20: Left lateral post-op smile Fig. 21: Right lateral post-op smile

Author's Bio

Dr. John Nosti practices full-time in Mays Landing, New Jersey, and Manhattan, New York, with emphasis on functional cosmetics, full-mouth rehabilitations and TMJ dysfunction. Or. Nosti's down-to-earth approach and ability to demystify occlusion has earned him distinction amongst his peers, the is clinical director of The Clinical Mastery Series (ClinicalMastery.com), a CE series dedicated to improve one's knowledge of occlusion, cosmetics and rehabilitations. He holds fellowships in the Academy of General Dentistry, Academy of Comprehensive Esthetics and International Congress of Oral Implantologists, Dr. Nosti is a member of the American Academy of Cosmetic Dentistry, American Academy of Craniofacial Pain and the American Dental Association.

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- One of the primary goals of smile design is to:
 - a. Convince the patient of a selected treatment
 - b. Communicate the patient's goals
 - c. Record photos for future marketing purposes
 - d. Determine how unrealistic the patient is
- Which of the following is true of feldspathic restorations?
 - a. Report a flexural strength of nearly 185MPa
 - b. Provide superior results when bonding to dentin due to their increased fracture resistance
 - c. They are fabricated through the lost wax technique
 - d. Have the ability to modify opacities within the same restoration
- Which of the following is true of IPS e.max Press restorations?
 - a. Reports a monolithic flexural strength of 185MPa
 - b. Reports a monolithic flexural strength of 400MPa
 - c. Is fabricated from a powder:liquid "stacked" process
 - d. Has the ability to modify opacities within the same
 - restoration
- Temporary veneers serve the following purpose(s):
 - a. Aid in patient communication in the smile design process
 - b. Aid in laboratory communication in the smile design process
 - c. Provide the ability to test drive the aesthetic and functional outcome
 - d. All of the above
- 5. Which of the following are ideal indications for "no-prep" restorations?
 - a. Desired shade change is eight shades lighter than current
 - b. Pre-operative teeth are crowded or rotated
 - c. Large interproximal spaces present
 - d. Increased length change desired

- 6. Which of the following is/are indication(s) to break contact in veneer preparation design?
 - a. Large existing interproximal restoration is present
 - b. Changing the mesial/distal width of a tooth
 - c. Changing the proximal contact
 - d. All of the above
- 7. Most dual-cure cements are ideal for the use in veneer cementation.
 - a. True
 - b. False
- 8. Placing the mock-up (diagnostic wax-up) prior to full preparation is an important step to allow what?
 - Maximum reduction of the teeth, which provides the lab at least 2mm of clearance for ceramic fabrication
 - b. The ceramist to visualize the preparations required
 - c. Uniform and conservative reduction from the final restoration position
 - d. All of the above
- 9. Teeth affected by erosion are never good candidates for veneers/all porcelain restorations.
 - a. True
 - b. False
- 10. Determining the ideal incisal position can be achieved by all of the following, except:
- a. Using an approximate measurement of 22mm from the mucobuccal fold to incisal edge position
 - b. Functionally determining the length necessary from protrusive and laterotrusive concerns
 - c. Phonetics ("F" and "V" sound)
 - d. Using an ideal CEJ-CEJ measurement of 17mm for Class I patients

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