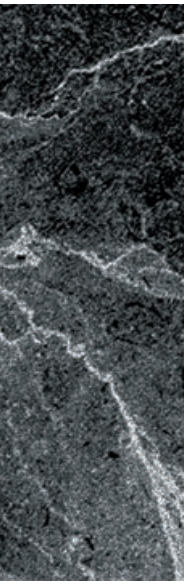

Critical Appraisal

CLINICAL CONSIDERATIONS FOR RESTORING MANDIBULAR INCISORS WITH PORCELAIN LAMINATE VENEERS

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Porcelain laminate veneers have been proven to be a successful treatment modality for maxillary incisors in clinical practice and in controlled clinical studies. However, the data in clinical studies on the success of veneers for restoring mandibular incisors are limited. Clinically, the successful restoration of mandibular incisors with porcelain laminate veneers is one of the more challenging procedures in all of esthetic restorative dentistry. Limited coronal dimensions, the small amount of enamel available for bonding (particularly in the cervical areas), materials and techniques for the bonding procedures, and the response of the tooth–veneer complex to forces generated during the incisal loading in both functional as well as parafunctional contacts must be considered as potential sources of success or failure.

This Critical Appraisal reviews three recent scientific articles to shed some light on these issues and, as in all research endeavors, leads the reader to identify additional areas of concern that might stimulate further scientific inquiry.

The first publication studied predictors for enamel thickness for mandibular incisors. The second examined bonding protocols for exposed dentin and suggested immediate dentin sealing. The third paper addressed fracture behavior of mandibular incisors restored with porcelain laminate veneers in vitro.

PREDICTORS OF VARIATION IN MANDIBULAR INCISOR ENAMEL THICKNESS

N.E. Hall, S.J. Lindauer, E. Tufekci, B. Shroff
Journal of the American Dental Association 2007 (138:809–15)

ABSTRACT

Objective: The purpose of this study was to identify predictors to aid orthodontists in determining the interproximal enamel thickness of mandibular incisors. Stripping (interproximal enamel reduction) is sometimes needed to help properly align mandibular incisors as part of comprehensive orthodontic treatment.

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Materials and Methods: Eighty human subjects with straight, non-restored mandibular incisors were divided into two groups. The first group consisted of 40 African-American subjects, and the second group consisted of 40 white subjects. Each group contained an equal number of males and females. Two digital periapical radiographs of the right and left lateral and central incisors of each subject were made. Alginate impressions were made to fabricate stone casts. Incisal widths were measured on the dental casts to calibrate incisal widths measured from radiographs projected on a 19-in. computer monitor. Measurements of enamel were made from the interproximal contact point to the dentinoenamel junction (DEJ) for both the mesial and distal aspects.

Results: Proximal enamel thickness ranged from 0.44 to 1.12 mm for white subjects and 0.58 to 1.28 mm for African-American subjects. A significant difference was detected in the enamel thickness of the distal and mesial aspects of both the lateral and central incisors. The distal enamel averaged 0.10 ± 0.09-mm thicker than the mesial enamel ($p < 0.0001$). Lateral incisors had significantly thicker enamel both mesially and distally than central incisors. No significant difference was detected between genders. African-American subjects had significantly thicker enamel then white subjects on all corresponding surfaces.

Conclusions: A statistically significant difference in the thickness of proximal surface enamel of mandibular incisors was found between the central and lateral incisors, mesial and distal surfaces, and white and African-American individuals.

COMMENTARY

The purpose of this investigation was to give orthodontists information on predictors of enamel thickness prior to commencing interproximal reduction procedures. For this reason, the design of the study did not involve the labial, cervical, and incisal enamel thicknesses. In the context of preparation design for porcelain laminate veneers, the conclusions of the study could partially affect preparation design considerations for mandibular incisors porcelain laminate veneers at the interproximal area. Because the preparation design is diagnostically driven to ensure minimal tooth reduction with optimal preservation of the enamel, the prospective restoration contours and measurements of proximal enamel thickness taken from the patients' existing radiographs may prove to be an adjunct tool in the process. Most of the studies evaluating the thickness of the enamel at the labial, cervical, and incisal surfaces have been conducted on the maxillary dentition. Such studies evaluating the enamel thickness in the corresponding areas of mandibular incisors would be of great value for restorative dentists.

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Ferrari M, Patroni S, Balleri P. Measurement of enamel thickness in relation to reduction for etched laminate veneers. Int J Periodontics Restorative Dent 1992;12:407–13.

IMMEDIATE DENTIN SEALING IMPROVES BOND STRENGTH OF INDIRECT RESTORATIONS

P. Magne, T.H. Kim, D. Cascione, T. Donovan

Journal of Prosthetic Dentistry 2005 (94:511–9)

ABSTRACT

Objective: The purpose of this study was to assess the microtensile bond strengths of indirect restorations using different bonding protocols. A comparison between delayed dentin sealing and immediate dentin sealing was made. Immediate dentin sealing incorporates a three-step dentin adhesive that is applied to freshly cut dentin prior to making the

definitive impression. Delayed dentin sealing occurs when the adhesive is applied to dentin at the delivery appointment of the definitive restoration.

Materials and Methods: Extracted human molars were prepared with a flat midcoronal dentin surface. The teeth were divided into three groups of five. All groups used a three-step etch-prime-bond regimen (OptiBond FL, Kerr, Orange, CA, USA) following its manufacturer's protocol and were restored with composite-resin material (Z100, 3M ESPE, St. Paul, MN, USA). In the control group, the bonding agent was applied immediately following preparation, and the teeth were restored with a direct composite-resin restoration.

The first experimental group (delayed dentin sealing) was provisionalized and stored in saline for 2 weeks prior to receiving an indirect restoration. On the day of delivery, the dentin was cleaned with airborne-particle abrasion and then bonded with a dentin adhesive and indirect composite-resin restoration.

The second experimental group (immediate dentin sealing) received the three-step etch-and-rinse adhesive on the day of preparation prior to the impression. Glycerin gel was applied after the initial polymerization of the adhesive, followed by 10 more seconds of light exposure to polymerize the oxygen-inhibition layer. After a storage period of 2 weeks, provisionals were removed, and the preparations were cleaned with airborne-particle abrasion. The adhesive and indirect composite restoration were bonded to the surface. Multiple beams were prepared from each specimen and placed in a microtensile tester.

Results: The mean microtensile bond strengths for the control and the immediate dentin sealing groups were 55.06 and 58.25 MPa, respectively. The mean bond strength for the delayed dentin sealing group was significantly lower (11.58 MPa).

Conclusions: Freshly cut dentin should be sealed with a three-step dentin bonding agent immediately following tooth preparation to improve the bond strength between the dentin and the bonding agent.

COMMENTARY

Different bonding protocols for enamel and dentin are critical for obtaining successful long-term integrity of the bonded porcelain laminate veneer. A multiple appointment procedure, such as the porcelain laminate veneer, allows clinicians to optimize the bond of the adhesive to tooth structure by applying the adhesive to any exposed dentin on the day of preparation and accomplishing the enamel bonding on the day of delivery. The freedom to have different days for separate bonding protocols might simplify such a technique-sensitive procedure. It should be emphasized that, although it has been demonstrated that immediate dentin sealing improves the quality of the adhesion to dentin in vitro, clinicians must make an effort to limit their preparation to enamel as much as possible to facilitate long-term success, as clinical studies have demonstrated. With mandibular incisors, where the likelihood of dentin exposure is increased, the use of selective immediate bonding sealing may facilitate clinical results.

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Layton D, Walton T. Up to 16-year prospective study of 304 porcelain veneers. Int J Prosthodont 2007;20:389–96.

Aboush YE. Removing saliva contamination from porcelain veneers before bonding. J Prosthet Dent 1998;80:649–53.

Magne P, So WS, Cascione D. Immediate dentin sealing supports delayed restoration placement. J Prosthet Dent 2007;98:166–74.

FRACTURE BEHAVIOR OF HUMAN MANDIBULAR INCISORS FOLLOWING ENDODONTIC TREATMENT AND PORCELAIN VENEER RESTORATION

H.H.W. Ho, F.C.S. Chu, A.N. Stokes

International Journal of Prosthodontics 2001 (14:260–4)

ABSTRACT

Objective: The purpose of this in vitro study was to evaluate modes of failure for mandibular incisors with different combinations of endodontic treatment and porcelain laminate veneers.

Materials and Methods: Forty mandibular incisors of equal labiolingual widths were divided into four test groups. Group A (the control) was intact teeth; group B received endodontic therapy and was restored with a direct composite-resin restoration to close the access opening; group C received labial porcelain laminate veneers; and group D consisted of a combination of groups B and C. The teeth that received endodontic treatment, groups B and D, were instrumented with the standard step-down technique.

Preoperative silicone matrices were fabricated for all teeth in groups C and D to evaluate the amount of tooth reduction and the final contours of the porcelain laminate veneers. All veneer preparations were intra-enamel, with gingival chamfer finish line 1-mm coronal to the cementoenamel junction. There was no incisal reduction, and the incisal edges received a feather-edge finish line. Porcelain veneers were bonded with Nexus (Kerr, Orange, CA, USA) dual-cure resin cement following the manufacturer's instructions. Specimens were mounted for loading and stored in water at room temperature for 7 days before testing. Specimens were positioned at a 30° angle to the long axis in a universal load-testing machine. The point of load was located 1 mm below the incisal edge on the labial, at a rate of 5 mm/minute until fracture.

Results: No significant difference in fracture load was detected between the groups. The mode of failure with the highest incidence was horizontal root fracture, whereas crown–root fractures were the least common. Half of the porcelain laminate veneers in groups C and D fractured in paths similar to the one observed with the intact tooth group. Five veneers in each group had fragments that debonded. The debonded fragments had no correlation with the path of tooth fracture.

Conclusions: Mandibular incisors restored with porcelain laminate veneers with or without endodontic therapy had the same mode of failure as intact teeth when under the same magnitude and direction of load.

COMMENTARY

This study addresses clinically important questions regarding modes of failure of mandibular porcelain laminate veneers and whether endodontically treated teeth can be predictably restored with porcelain laminate veneers rather than with complete-coverage restorations. Restoring mandibular incisors with full-coverage crowns can be challenging because those teeth are the smallest in the permanent dentition. Thus, using porcelain laminate veneers as an alternative treatment modality might prove to be a more conservative and predictable option. With a constant load, delivered at a 30° angle of the labial surface, porcelain laminate veneers on mandibular incisors failed in a manner comparable to that of intact mandibular incisors. Further studies evaluating facture load of mandibular incisors with different levels of coronal tooth structure loss would be valuable.

SUGGESTED READING

Wall JF, Reisbick MH, Johnston WM. Incisal-edge strength of porcelain laminated veneers restoring mandibular incisors. Int J Prosthodont 1992;5:441–6.

Castelnuovo J, Tjan AHL, Philips K, Nicholls JI, Kois JC. Fracture load and mode of failure of ceramic veneers with different preparations. J Prosthet Dent 2000;83:171–80.

Magne P, Douglas WH. Cumulative effects of successive restorative procedures on anterior crown flexure: intact versus veneered incisors. Quintessence Int 2000;31:5–18.

THE BOTTOM LINE

Restoring mandibular incisors with porcelain laminate veneers is a challenging endeavor facing restorative dentists. Three scientific papers have been reviewed in an attempt to shed some light on some clinical challenges associated with mandibular porcelain laminate veneers.

The first paper, "Predictors of variation in mandibular incisor enamel thickness," addressed the amount of enamel available on the proximal surfaces of the incisors in question. Although the intention of the study was to support orthodontic considerations relative to the stripping of contacts, its findings indirectly influence restorative considerations on case selection and preparation design for porcelain laminate veneers. The authors found that wider incisors had thicker enamel as compared with thinner incisors, and proximal enamel had a wide range of thickness from 0.44 to 1.28 mm between patients. This finding could help clinicians evaluate which patients would be at high risk for dentin exposure during veneer preparation. Veneer preparations on wider incisors might have a higher probability of remaining intra-enamel and not exposing dentin at the proximal finish line of the veneer preparation. In addition, this study concluded that the distal proximal enamel is thicker than the mesial proximal enamel. Because of the variable enamel thicknesses among and within patients, measurements from existing radiographs could aid with intra-enamel preparation designs. Preoperative calibration of the patient's preexisting radiographs could give restorative dentists good clinical predictors for evaluating interproximal enamel thickness before the preparation is started. Further studies are needed to predict labial enamel thickness prior to preparation, in particular at the cervical area adjacent to the intended finish line.

The bonded composite-resin interface between the veneering material and the tooth is a potential source of success or failure. Mandibular incisors have a high potential of dentin exposure because of their limited coronal dimensions. The fact that dentin bonding is not as predictable as enamel bonding increases the challenge with mandibular porcelain laminate veneers. The second paper, "Immediate dentin sealing improves bond strength of indirect restorations," offered a unique approach to use both days of a two-appointment procedure to divide the technique-sensitive bonding procedures into two. The study showed that applying a three-step etch-and-rinse adhesive on the day of preparation, prior to making the impression, improved dentin bond strength when compared with applying the same bonding agent on the day of delivery of the indirect composite-resin veneers. The ability to divide bonding procedures for enamel and dentin in two separate appointments will conceptually simplify the complex bonding procedure of indirect restorations and might prove to increase the long-term success of porcelain laminate veneers.

The third and final paper, "Fracture behavior of human mandibular incisors following endodontic treatment and porcelain veneer restoration," provided valuable information on the effect of shear forces applied to incisors restored with a veneer or with a veneer after endodontic treatment. Some concerns have been expressed regarding the long-term predictability of porcelain laminate veneers as definitive restorations of endodontically treated teeth. Extrapolation of shear tests is difficult because they evaluate only a single mode of failure. Thus, the results of this study can be expected to lead to future studies that address other modes of failure, such as thermal cycling, fatigue loading, and amount of residual tooth structure. Clinical studies with a large sample of mandibular incisors restored with porcelain laminate veneers with and/or without endodontic treatment and using contemporary adhesive bonding protocols are imperative to create definitive guidelines.

Interpreting the results of the three distinctly different scientific papers presented can help to develop an approach to restoring mandibular incisors with porcelain laminate veneers. Although all of the above papers were not designed for the specific restoration in question and they are scientifically different, reviewing them together should help readers to formulate a philosophy and to identify additional areas in need of further evidence-based research.

Editor's Note: We welcome readers' suggestions for topics and contributors to Critical Appraisal. Please address your suggestions to the section editor:

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