Journal of Dental Applications

Open Access

Austin Publishing Group

Original Article

Are Noninvasive Porcelain Veneers Suitable for Everyone?

Almeida e Silva J[1,2]*, Zanardi G[3,4] and Baratieri LN[5]

[1]Operative Dentistry, Federal University of Santa Catarina, Florianópolis, Brazil

[2]Visiting Researcher, Department of Prosthodontics, Ludwig-Maximilians University, Munich, Germany

[3]Orthodontics, State University of Rio de Janeiro, Rio de Janeiro, Brazil

[4]Fellow Researcher and Collaborator, Department of Orthodontics, University of North Carolina, Chapel Hill, USA

[5]Former Chair, Operative Dentistry Division, Federal University of Santa Catarina Florianópolis, Brazil

***Corresponding author:** Júnio Almeida e Silva, Rua Julieta Lins 415 Ed, Dom Leonardo Apt, 701, Pioneiros, Balneário Camboriú, Santa Catarina, Brazil

Received: January 11, 2018; **Accepted:** February 16, 2018; **Published:** March 01, 2018

Abstract

Clinicians and researchers have long sought conservative treatment approaches to restore anterior teeth with long- lasting and esthetic materials. This endeavor led to the development of ceramic systems that wed aesthetics with function. Accordingly, fabricating porcelain veneers without or with minimal tooth preparation became possible reinforcing the concept that the noninvasive porcelain laminate veneers can become versatile and conservative allies of the esthetic dentistry. However, even though noninvasive veneers can serve as an alternative to classic and extended veneers or even to full crown preparations, they are not the best choice for all clinical situations. Therefore, choosing the most adequate restorative approach when restoring the anterior dentition is crucial to achieving a conservative and long-lasting treatment. This article addresses key evidence-based considerations regarding the rehabilitation of the anterior dentition using porcelain crowns, traditional, extended and noninvasive veneers.

Keywords: Ceramic; Porcelain veneers; Dental adhesion

Introduction

Increasing esthetic demands have led to the development of ceramic systems that currently wed aesthetics with function. This endeavor has been marked by new porcelain compositions and innovative restorative techniques which enabled more conservative restorative approaches, such as the porcelain veneers [1,2]. In 1983 and 1984, Simonsen and Calamia [3,4], showed that the bond strength of a hydrofluoric acid-etched and silanated porcelain to the luting composite resin was routinely greater than the bond strength of the very same luting composite resin to the acid-etched enamel surface, hence forming a strong porcelain/luting composite/tooth adhesion complex. Since then, the clinical performance of adhesively luted porcelain veneers has been successful and clinically proven [4-9], and these restorations now stand as an excellent restorative solution to provide long-lasting and esthetic results. Additionally, according with Magne and Douglas [10], a restored tooth with a porcelain laminate veneer that is subjected to a posterior-anterior strength, recovers its coronary stiffness from 89% up to 96% in comparison with a healthy tooth. Accordingly, porcelain laminate veneers are an excellent combination of hardness, resistance and resilience.

However, the combination of media-driven treatment plans, rushed-to-the-market products, and dentists eager to satisfy their patients' esthetic demands have formed a dangerous triad with little concern for the risk/benefit calculus of dental treatment [1]. The resulting overuse of porcelain veneers is likely a result of these new reinforced ceramics, which have a broader range of indications and which have led to the replacement of traditional veneer preparations with extended defect-oriented preparation designs [11-13].

On the other hand, all-ceramic crowns have been used extensively in prosthodontics over the past few years because their clinical success has been similar to that of metal-ceramic crowns, with excellent survival rates of 98.9% in the anterior region after 11 years [1,14-16]. The main causes of failure include catastrophic fracture, chipping of the veneer ceramic and secondary caries [7]. Although porcelain veneers are a minimally invasive approach compared to crowns, less tooth reduction does not always result in increased longevity. It has been shown that after 10 years of clinical service, reintervention without restoration replacement occurs in 36% of teeth restored with porcelain veneers, whereas 7% of teeth restored with porcelain veneers might receive a more invasive treatment approach [14,17]. The main reported causes of porcelain veneer failure include fracture, microleakage, and debonding. That is to say, porcelain veneers are more susceptible to future interventions; therefore, it is crucial that the clinician be aware of the correct indications for porcelain veneers to provide the ideal result in terms of longevity [18].

Ceramics are particularly well suited for veneer restorations and should be used primarily in conjunction with an additive approach to restore missing enamel; therefore, it is paramount that the ceramic system used can be bonded to the tooth substrate [19]. Accordingly, pressed leucite and lithium-disilicate reinforced glass-ceramics offer favorable esthetic and mechanical properties [14,20], allowing for the fabrication of noninvasive porcelain laminate veneers. This technique involves the use of thin porcelain laminate veneers (0.1 to 0.7 mm in thickness) placed on the visible portion of the enamel, with minimal or preferably no tooth reduction [21,22].

Notwithstanding the benefits of porcelain veneers, in order to optimize the longevity of porcelain restorations in the anterior dentition the clinician must have a thorough understanding of all patient-related factors, the quality of the remaining tooth tissue, and the proper ceramic system for the individual situation so that a correct restorative approach is applied [2,13,14,23]. This article addresses key evidence-based considerations regarding the rehabilitation of the anterior dentition using porcelain crowns, traditional, extended and

Citation: Almeida e Silva J, Zanardi G and Baratieri LN. Are Noninvasive Porcelain Veneers Suitable for Everyone?. J Dent App. 2018; 5(1): 403-406.

Figure 1:

Figure 2:

noninvasive veneers.

Patient Related Factors

As with any restorative approach, patients with high caries activity do not respond well to treatment because of the high incidence of secondary caries, especially if the preparation margins are localized on dentin [24,25]. For these patients, any attempt to restore the anterior dentition with all-ceramic crowns and any kind of veneers should only be made if preventive and monitoring measures have been carried out [26].

Age matters. The longevity of porcelain veneers can be compromised in individuals over the age of 60 [27]. There may be an increased load due to the lack of posterior dentition, reduced salivary flow resulting from the use of medication, and periodontal problems that can weaken the stability of the tooth (Figure 1). Because enamel thickness diminishes over time, porcelain veneers in elderly patients also do not perform as well because the cervical area of the tooth may have little or no enamel [27,28]. Root dentin exposure is common [29], and thus the preparation margins are usually localized on dentin, which is related to microleakage incidence [30]. Consequently, porcelain crowns are more recommended rather than veneers for elderly patients. Patient compliance with the clinician's recommendations is also particularly important in such cases.

Remaining Tooth Tissue

The amount and quality of remaining tooth tissue is an essential factor when choosing between all-ceramic crowns and veneers in the anterior dentition. During elaboration of the treatment plan, the clinician must verify whether the tooth is endodontically treated or vital. If the tooth is nonvital, the need for placement of intraradicular posts must be evaluated, and the clinician should bear in mind that a minimum of 1mm in height of sound dentin must be maintained circumferentially as ferrule design after post placement [31]. The presence of darkened substrate is common for nonvital teeth, and an extra reduction may be required to provide room for an esthetic restoration, hence coronal dentin exposure is very likely in such cases [32,33]. Therefore, all-ceramic crowns are superior to veneers for nonvital teeth because they provide increased strength, retention, esthetics, and longevity [23,32,33].

Table 1: Some *in vitro* studies in which failures were attributed both to the presence of dentin and composite within the remaining prepared tooth tissue.

Study	Time	Number of veneers	Failure rate %
Dunne & Millar, 1993 [41]	10 years	550	27%
Fradeani, 2005 [7]	5,7 years	182	5,6%
Guess, 2008 [11]	5 years	66	3%
Dumfahrt, 2000 [17]	10 years	205	4%

Porcelain veneers should only be chosen when bonding is a completely feasible option, which means the more enamel the better. The tooth preparation should be confined primarily within the enamel shell or should display a substantial 80% enamel area [30,34]. To ensure the presence of enamel in the whole preparation, the traditional porcelain veneer technique determines the following preparation guidelines: Slight modification of labial enamel to reduce bulges; shallow chamfer 0.5mm incisal or occlusal to the cervical line of the tooth in the gingival enamel; slight incisal overlap to ensure that the composite margins are not subjected to occlusal forces and proximal preparation terminated facial to the contact areas [35-37].

As demonstrated by Edelhoff and Sorensen [38], full crown preparations require removal of extensive tooth structure, thus modifications of established veneer preparations were made creating defect-oriented veneer preparations, the so called extended veneers [11] or "full veneers" [39] by extending the designs to the proximal and palatal areas in cases where such tooth regions aren't sound. Debonding of porcelain veneers has been reported to occur when dentin comprises 80% or more of the tooth substrate. In contrast, debonding is highly unlikely when a minimum of 0.5mm of enamel remains peripherally [1,30,34]. Therefore, to avoid microleakage and secondary caries, it is crucial that the preparation margins are bound by enamel and do not end in composite resin fillings [27,37,40]. Moreover, partial adhesion to dentin or to extensive composite resin restorations and high load during static and/or dynamic occlusion increase susceptibility to porcelain fracture [1]. If dentin is the main bondable substrate or if there are extensive Class III and IV composite resin restorations whose dimensions extend beyond the crown, all-porcelain crowns or extended veneers should be the primary restorative choices. Table 1 corroborates the concept that porcelain veneers ought to be bonded on enamel by showing in vivo studies which in the failure rates are attributed to veneers placed on dentin or on existing composite restorations.

When it comes to noninvasive veneers a no-preparation-approach must preferably be carried out, thus as a highly conservative esthetic

Table 2: Recommendations for choosing between all-ceramic crowns, extended, traditional and non invasive veneers on anterior dentition.

	All-ceramic crowns	Extended veneers	Traditional veneers	Noninvasive veneers
Preparation margin exclusively located in dentin	+	-	-	-
Non-vital teeth	+	-	-	-
Presence of extensive composite fillings	+	-	-	-
Presence of large area of enamel including preparation margins	-	+	+	+
Discolored teeth	+	– / +*	– / +*	–
Improper insertion axis	+	+	+	-
Limited buccal space	+	+	+	-
Need of significant alteration of buccopalatal position	+	+	-	-

+Recommended; -Not recommended; *If non-translucent ceramic is employed.

option, it is only indicated for small corrections of incisal chipping, tooth fracture, conoid teeth, diastemata and tooth augmentation. Therefore, despite of the clinicians' intended minimal invasiveness, only a small percentage of the patients are eligible for noninvasive veneers.

Ceramic System

In a recent review conducted by Della Bona and Kelly [15], it was concluded that for veneers and crowns for single-rooted anterior teeth, clinicians may choose from any of the all-ceramic systems available. However, the choice of ceramic system is highly dependent on the type of restoration (crown or veneer), type of cementation (adhesive or traditional), and esthetic and functional demands (Figure 2).

Porcelain is particularly well suited for veneer restorations and should be primarily used with an additive approach to restore missing enamel. Therefore, it is paramount that the ceramic system allows for surface treatment by etching with hydrofluoric acid followed by silanization prior to bonding to the tooth substrate [1,33]. Further, since esthetics is of primary concern for the anterior dentition, an adequate ceramic system for veneers should have a relatively translucent core for the ceramist to build in color intrinsically. As a result of the veneer's thin thickness, the color of the dental substrate might impair the final aesthetic outcome. Jorgenson & Goodking [42] and Volpato et al. [43] have reported that the correct selection of a ceramic system involves the assessment of the dental substrate's color, the thickness of ceramic material, its degree of translucency and its masking ability. Accordingly, spite of the proven clinical success [11,15] and the aesthetic characteristics pressed leucite glass-ceramics present, lithium-disilicate glass- ceramics provide better strength and responds chromatically better with small thicknesses than leucite glass-ceramics do in cases with discolored abutment teeth [44,45]. In order to minimize the influence of the dental substrate on the final restoration color, bleaching techniques prior to the treatment or the use of different shades of resin cements are recommended.

For all-ceramic crowns, a broader range of systems can be used. Leucite glass-ceramic and lithium-disilicate glass-ceramic (IPS e.max, Ivoclar Vivadent) are suitable for cases in which adhesive bonding is possible. Leucite glass- ceramics especially rely on the bond strength between tooth and porcelain and provide good esthetics with proven longevity [14-16,46]. Ceramics that cannot be etched and bonded, such as alumina- and zirconia-based ceramics, are known as high-strength all-ceramic materials due to their improved physical properties. These are best used in patients with high functional or parafunctional loads. On the other hand, such ceramics present inferior esthetic features compared to glass-ceramics. Alumina and zirconia systems are recommended for cases in which adhesive cementation is not feasible [14,15]. These systems, along with monolithic lithium-disilicate crowns can be conventionally luted with glass-ionomer, which are less technique-sensitive than adhesive cementation [29,47,48]. Table 2 summarizes the recommendations of all-ceramic crowns, extended, traditional and noninvasive veneers in the anterior dentition.

Conclusion

The main advantages of adhesive dentistry may be completely misconceived when bonding porcelain veneers while ignoring the basic fundamentals that have made these restorations successful for nearly three decades. It is very important to bear in mind that despite of the patients' media-driven desire for noninvasive veneers, such restorations are rarely indicated.

Clinical Relevance

It is paramount that the clinician knows the scientific criteria to indicate all porcelain restorations inasmuch as their longevity is highly dependent on patient-related, remaining tooth tissue, and ceramic system factors.

Disclosure Statement and Acknowledgements

The authors do not have any financial interest in the companies whose materials are included in this article. Our special thanks to João Paulo Garcia, Dental Technician, for the manufacturing of the porcelain restorations displayed on the illustrated case report.

References

1. Sadowsky SJ. An overview of treatment considerations for esthetic restorations: A review of the literature. J Prosthet Dent. 2006; 96: 433–442.

2. Almeida e Silva JS, Rolla JN, Edelhoff D, Araújo E, Baratieri LN. All-ceramic crowns and extended veneers in anterior dentition: A case report with critical discussion. Am J Esthet Dent. 2011; 1: 60–81.

3. Simonsen RJ, Calamia JR. Tensile bond strength of etched porcelain. J Dent Res. 1983; 62: 297.

4. Calamia JR, Simonsen RJ. Effect of coupling agents on bond strength of etched porcelain. J Dent Res. 1984; 63: 179.

5. Guess PC, Stappert CFJ. Midterm results of a 5-year prospective clinical investigation of extended ceramic veneers. Dent Mater. 2008; 24: 804–813.

6. Bona Della A, Kelly JR. The clinical success of all-ceramic restorations. J Am Dent Assoc. 2008; 139: 8S–13S.

7. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation: A retrospective study. Int J Periodontics Restorative Dent. 2005; 25: 9–17.

8. Fradeani M. Six-year follow-up with Empress veneers. Int J Periodontics Restorative Dent. 1998; 18: 216–225.

9. Beier US, Kapferer I, Burtscher D, Dumfahrt H. Clinical performance of porcelain laminate veneers for up to 20 years. Int J Prosthodont. 2012; 25: 79–85.

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

11. Guess PC, Stappert CFJ. Mid-term results of a 5-year prospective clinical investigation of extended ceramic veneers. Dent Mater. 2008; 24: 804–813.

12. Christensen GJ. Facing the challenges of ceramic veneers. J Am Dent Assoc. 2006; 137: 661–664.

13. Spear FM, Kokich VG, Mathews DP. Interdisciplinary management of anterior dental esthetics. J Am Dent Assoc. 2006; 137: 160–169.

14. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: A systematic review. J Prosthet Dent. 2007; 98: 389–404.

15. Della Bona A, Kelly JR. The clinical success of all-ceramic restorations. J Am Dent Assoc. 2008; 139: 8S–13S.

16. Fradeani M, Redemagni M. An 11-year clinical evaluation of leucite-reinforced glass-ceramic crowns: A retrospective study. Quintessence Int. 2002; 33: 503–510.

17. Dumfahrt H, Schäffer H. Porcelain laminate veneers. A restrospective evaluation after 1 to 10 years of service: Part II—Clinical results. Int J Prosthodont. 2000; 13: 9–18.

18. Elderton RJ. Clinical studies concerning re-restoration of teeth. Adv Dent Res. 1990; 4: 4–9.

19. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: A review of the literature. J Dent. 2000; 28: 163–177.

20. Kelly JR, Benetti P. Ceramic materials in dentistry: Historical evolution and current practice. Aust Dent J. 2011; 56: 84–96.

21. Christensen GJ. Veneering of teeth. State of the art. Dent Clin North Am. 1985; 29: 373–391.

22. Quinn F, McConnell RJ, Byrne D. Porcelain laminates: A review. Br Dent J. 1986; 19: 61–65.

23. Christensen GJ. Are veneers conservative treatment? J Am Dent Assoc. 2006; 137: 1721–1723.

24. Kidd EAM, Fejerskov O. What constitutes dental caries? Histopathology of carious enamel and dentin related to the action of cariogenic biofilms. J Dent Res. 2004; 83: 35–38.

25. Magne P, Kwon KR, Belser UC, Hodges JS, Douglas WH. Crack propensity or porcelain laminate veneers: A simulated operatory evaluation. J Pros- thet Dent. 1999; 81: 327–334.

26. Yoshiyama M, Tay FR, Doi J, et al. Bonding of self-etch and total-etch adhesives to carious dentin. J Dent Res. 2002; 81: 556–560.

27. Burke FJT, Lucarotti PSK. Ten-year outcome of porcelain laminate veneers placed within the general dental services in England and Wales. J Dent. 2009; 37: 31–38.

28. Featherstone JD. The science and practice of caries prevention. J Am Dent Assoc. 2000; 131: 887–899.

29. Tay FR, Pashley DH. Resin bonding to cervical sclerotic dentin: A review. J Dent. 2004; 32: 173–196.

30. De Munck J, Van Meerbeek B, Yoshida Y, et al. Four-year water degradation of total-etch adhesives bonded to dentin. J Dent Res. 2003; 82: 136–140.

31. Cheung W. A review of the management of endodontically treated teeth. Post, core and the final restoration. J Am Dent Assoc. 2005; 136: 611–619.

32. Meijering AC, Creugers NHJ, Roeters FJM, Mulder J. Survival of three types of veneer restorations in a clinical trial: A 2.5-year interim evaluation. J Dent. 1998; 26: 563–568.

33. Donovan TE. Factors essential for successful all-ceramic restorations. J Am Dent Assoc. 2008; 139: 14S– 18S.

34. Friedman MJ. A 15-year review of porcelain veneer failure-A clinician's observations. Compend Contin Educ Dent. 1998; 19: 625–630.

35. Calamia JR. Indications for porcelain veneers. Etched porcelain veneers: a new treatment modality. N Y J Dent. 1983; 53: 255–259.

36. Horn H. A new lamination, porcelain bonded to enamel. N Y State Dent J. 1983; 49: 401–403.

37. Burke FJ. Survival rates for porcelain laminate veneers with special reference to the effect of preparation in dentin: a literature review. J Esthet Restor Dent. 2012; 24: 257-265.

38. Edelhoff D, Sorensen JA. Tooth structure removal associated with various preparation designs for anterior teeth. J Prosthet Dent. 2002; 87: 503–509.

39. Crispin BJ. Expanding the application of facial ceramic veneers. J Calif Dent Assoc. 1993; 21: 43–54.

40. Peumans M, De Munck J, Fieuws S, Lambrechts P, Vanherle G, Van Meerbeek B. A prospective ten-year clinical trial of porcelain veneers. J Adhes Dent. 2004; 6: 65–76.

41. Dunne SM, Millar BJ. A longitudinal study of the clinical performance of porcelain veneers. Br Dent J. 1993; 175: 317–321.

42. Jorgenson MW, Goodkind RJ. Spectrophotometric study of five porcelain shades relative to the dimensions of color, porcelain thickness, and repeated firings. J Prosthet Dent. 1979; 42: 96–105.

43. Volpato CAM, Monteiro S, de Andrada MC, Fredel MC, Petter CO. Optical influence of the type of illuminant, substrates and thickness of ceramic materials. Dent Mater. 2009; 25: 87–93.

44. Edelhoff D, Brix O. All-ceramic restorations in different indications: A case series. J Am Dent Assoc. 2011; 142: 14S–19S.

45. Edelhoff D, Güth JF, Lungwirth F, et al. Light transmission through lithium-disilicate ceramics with different levels of translucency. J Dent Res. 2010: 89.

46. Suputtamongkol K, Anusavice KJ, Suchatlampong C, Sithiam-nuai P, Tulapornchа C. Clinical performance and wear characteristics of veneered lithia-disilicate-based ceramic crowns. Dent Mater. 2008; 24: 667–673.

47. Ozkurt Z, Kazazog˙lu E. Clinical success of zirconia in dental applications. J Prosthodont. 2010; 19: 64–68.

48. Etman MK, Woolford MJ. Three-year clinical evaluation of two ceramic crown systems: A preliminary study. J Prosthet Dent. 2010; 103: 80–90.