

Clinical Performance of Porcelain Laminate Veneers with Minimal Preparation: A Systematic Review

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ABSTRACT

Aim: To investigate the longevity of ceramic laminates with minimally invasive preparations.

Materials and methods: The research was conducted in PubMed, Web of Science, and Scopus databases, using the keywords “dental veneers” or “dental porcelain” or “dental laminates” and survival or survivorship or longevity or “follow-up studies” and Kaplan-Meier. The studies selected for analysis were clinical trials where the ceramic laminates were made with anywhere from no cavity preparation to minimum preparation with a 1 mm maximum depth.

Results: Of 197 citations identified, five studies were included.

Conclusion: The survival of the ceramic laminates with minimal preparation is satisfactory, which leads us to conclude that the technique has longevity for 10 years.

Keywords: Ceramic laminates, Dental porcelain, Dental veneers, Longevity, Survival.

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INTRODUCTION

The use of acid and adhesives was made possible with the advent of composite resins by Bowen in 1958. Subsequently, together with the work of Fusayama in 1978 and then Nakabayashi in 1982, the adhesiveness obtained produced effective results. Consequently, a decisive step was taken for the success of ceramic laminates, which, conditioned by acid through the technique developed by Rochette in 1973, transformed adhesiveness into reality.¹

With the growing demand for restorative treatments for anterior teeth, the need arose to utilize materials

that met the esthetic and functional needs of patients. Traditional resin composites, despite their simple, cost-effective, and esthetically favorable technique, exhibit more resistance and lower color stability than porcelains. Thus, a new restorative approach emerged, and ceramic laminates, characterized as indirect restorations, began to be used to restore changes in color, shape, or position through the coating of buccal surfaces.

In the 1980s, porcelain veneers earned a prominent place in cosmetic dentistry as great strides were taken within the sphere of ceramic laminates. New methods of preparation with minimal to no tooth wear became known as dental contact lenses. Thus, an alternative restorative treatment emerged and was considered more conservative when compared with crowns and traditional porcelain veneers, which cause increased wear of tooth structure.

Discretion must be used upon recommending dental lenses. Not all cases are suitable for the use of ceramic laminates in general, particularly the dental lenses, which could end up influencing the success of the procedure. One such limitation would be among patients who have parafunctional habits or who do not have balanced occlusion, among other factors. However, in the case of teeth that are stained, discolored, broken, misaligned, or with diastema or signs of aging, the possibility of using the dental lenses as a restorative material provides a good alternative.²

Therefore, to achieve good adhesion of these materials and, consequently, higher survival, it is ideal that such fragments have the largest possible contact area with enamel structure.³ When aiming to achieve good long-term retention, it is recommended to leave at least 50% of the enamel substrate, preferably at the supragingival level.⁴⁻⁶

In order to avoid the detachment of dental veneers, studies have been conducted to determine the appropriate amount of tooth structure that should be removed. Thus, the preparation of the tooth structure in order to receive the contact lenses on the buccal surface should vary from no preparation at all to preparation with a depth of 0.3–0.5 mm.

The use of dental lenses is recent, and few studies exist that demonstrate their clinical longevity. Thus, this article aims to provide a systematic review of the literature regarding the longevity of ceramic laminates known as

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dental lenses (with minimal wear of tooth structure), to bring the reader further clarification on the subject, and thus be able to assess the existence of scientific evidence for this restorative technique.

MATERIALS AND METHODS

Central Question

The focus of this analysis was: "What is the survival of minimally invasive ceramic laminates?"

Search Strategy

The databases searched to identify relevant studies were: PubMed/Medline, Web of Science, Scopus, and Cochrane.

Descriptors Used

"Dental veneers" or "dental porcelain" or "dental laminates" and survival or survivorship or longevity or "follow-up studies" and Kaplan-Meier.

Inclusion Criteria

Types of studies: Clinical trials or cohort, *in vivo*, with minimal dental preparation (with a depth of up to 1 mm), and articles published in English.

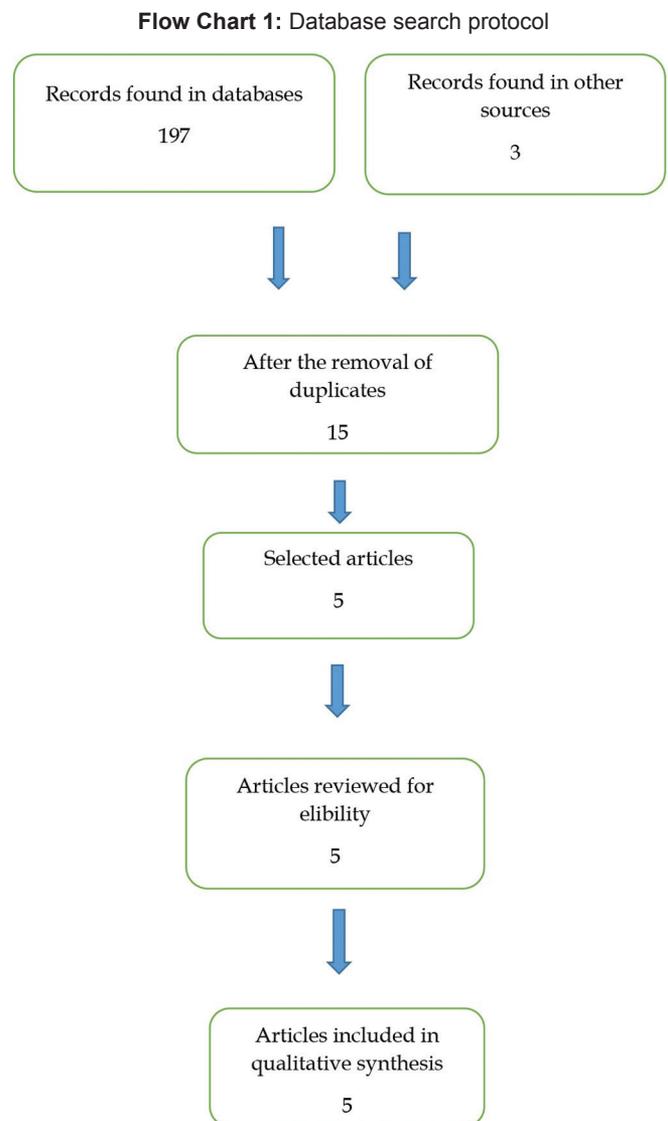
Exclusion Criteria

Studies where success rates and survival of ceramic laminates were not detailed.

RESULTS

The searches in the databases produced 197 articles, and the search for additional records from other sources produced 3 articles. After reading titles, abstracts, and removing duplicates, 15 articles remained. When evaluated for eligibility, five articles remained, which were included in the qualitative synthesis. The search flowchart is shown in Flow Chart 1. The studies are briefly described in Table 1.

In the Dumfahrt and Schaffer study,⁹ it was observed that only 4% of the ceramic laminates showed failures during the 10-year monitoring period. With regard to the coloration aspect, three ceramic restorations (2%) showed little difference between adjacent teeth. Further, marginal adaptation showed excellent results, and 99% of the laminates were rated as satisfactory by patients. However, a rate of 17% for marginal discoloration and 31% for failure involving gingival recession was observed. There were no cases that had secondary cavities and loss in the vitality of the teeth. The gingival recession was justified by the fact that the ceramic restorations were cemented at the gingival and subgingival level.⁹ Therefore, it was



concluded that the longevity was satisfactory in 91% of the ceramic laminates with minimal tooth wear, varying from 0.3 to 0.5 mm.

In the Nordb study,⁷ which accompanied 135 dental veneers cemented to 41 patients for 3 years, only seven cases of failure were reported, in which five were corrected with finishing and polishing, and only two demanded complete replacement of the ceramic restoration. There were no failures related to the marginal staining, nor the secondary cavities. Gingival recession problems were not considered significant,⁷ which, once again demonstrates satisfactory results with minimal dental wear of ceramic laminates (0.3–0.5 mm).

The Aykor and Ozel study,¹² which accompanied 300 ceramic laminates with up to 0.75 mm of tooth wear for 5 years, achieved very positive results. The marginal adaptation and discoloration results were relatively insignificant, with approximately 2% of failures. Postoperative sensitivity was reported in 12 teeth, which disappeared after the bonding agent was applied.

Table 1: Included studies

Study	Follow-up/sample	Evaluation criteria	Evaluation instrument	Results—success rate
Nordb, 1994 ⁷	3 years n = 135 Porcelain: feldspática/15% aluminum oxide Thickness of porcelain: 0.5–1.0 mm Dental preparation: (0.3–0.5 mm) with no incisal reduction	Adhesive failure wear Fractures Marginal integrity Cavities Discoloration Surface contour	Clinical exam Photographs	91% Statistical values: not informed
Meijering et al., 1998 ⁸	2.5 years n = 180 Porcelain: unspecified Wear: less than 1 mm	Fractures cracks adhesive failure alterations in color Cavities postoperative sensitivity	Clinical exam	95% porcelain with no incisal reduction 87% porcelain with incisal reduction (Kaplan–Meier) Statistical values: not informed
Dumfahrt and Schaffer, 2000 ⁹	10 years n = 191 Porcelain: unspecified Wear: 0.3–0.5 mm	Porcelain fracture Partial detachment with exposure of tooth structure Patient satisfaction	Clinical Exam Clinical Rating of Restorations (Modified CDA/Ryge Criteria) ¹⁰ Not informed	91% (Kaplan–Meier) 99% of laminates rated satisfactory by patient Statistical values: not informed
Smales and Etemadi, 2004 ¹¹	7 years n = 110 Porcelain: feldspathic Wear: less than 1 mm	Fractures adhesive failure Color incompatibility	Clinical exam	95.8% with coated incisal porcelain 85.5% without coated incisal porcelain (Chi-squared test. Fisher's exact—BMDP 1L (SPSS) No statistically significant difference (Mantel–Cox statistic = 2.294, df = 1, p = 0.130)
Aykor and Ozel, 2009 ¹²	5 years n = 300 Porcelain: glass-reinforced leucite Wear up to: 0.75 mm	Marginal adaptation Discoloration secondary cavities postoperative sensitivity color satisfaction periodontal evaluation	Clinical exam modified United States Public Health Service (USPHS) criteria ¹³	98% Statistical values: not informed

Regarding gingival response, 98% of the cases showed satisfactory results. After a 5-year follow-up, the patient satisfaction rate reached 98%. Only 2% of the results showed unsatisfactory rates related to the gingival tissue based on the discretion used.¹⁰ This occurred with the cases where the preparation of the tooth was subgingival, which supports the recommendation of “dental lens” ceramic laminates in cases where the preparations can be made supragingivally.⁴

In the Smales and Etemadi study,¹¹ which accompanied 50 patients over 7 years, the survival rate of ceramic laminates with minimal dental wear was 85%. Failures were mainly found in the detachment or fractures in the ceramic structure. Of the 110 laminates cemented on teeth, only six resulted in failure. The failures and detachments of ceramic restorations were closely related to fatigue and occlusal stress, along with incorrect selection by the patient and mistakes made during the clinical procedure. Even though the results of Smales were favorable to this type of dental preparation, more studies are needed to corroborate this claim.¹¹

During the 2.5-year follow-up carried out by Meijering et al,⁸ there were only a total of 11 failures within 180 ceramic laminates with less than 1 mm preparation, the equivalent of a 6% failure rate. This result indicates that the shortcomings are related to fractures in the ceramic laminates. The survival of these laminates showed positive effects when teeth with vitality were involved, and also showed that the preparation of and factors involving the operator are not related to the different survival rates.⁸

After the analysis of the results in the five selected studies, it can be concluded that there is longevity in ceramic laminates, if properly recommended, which justify their use. Moreover, with the advent of ceramic laminates with minimal preparation (up to 1 mm), pleasing esthetics and longevity can be obtained with maximum conservation of healthy tooth structure.

DISCUSSION

Ceramic laminates are currently considered a treatment alternative for teeth that are anatomically misshapen,

fractured, or discolored, as well as for diastema, often substituting more invasive procedures, such as fixed prostheses.¹

Several factors must be taken into consideration for the appropriate recommendation of a ceramic laminate. Since laminates made with minimal preparation, known as dental lenses, have not been discussed at length in scientific literature, appropriate recommendation is indispensable for the success of the procedure.

Despite the limited number of studies, the articles show the longevity of conducted clinical cases. Even though different methods and time periods of follow-up were used, both found satisfactory results with success rates ranging from 85.5 to 95.8%.^{7-9,11,12} This leads us to conclude that, within the limit of the follow-up of the studies, longevity does exist for ceramic laminates with minimal dental wear.

One of the failures cited in the selected papers, despite its occurrence in the low percentages, was related to fractures and detachments of porcelain. Occurring in patients with an occlusion outside the normal standards, a concentration of tension was generated which resulted in failure.⁹ This emphasizes the importance of appropriate recommendation for the successful use of the ceramic laminates in question.

It is essential to obtain a detailed medical history, so that the best treatment protocol can be established for patients who will use ceramic laminates known as dental lenses (with wear up to 1 mm). Patients with intrinsic stains, light coloration, unsuccessful teeth whitening, or who present conoids or diastema would be good candidates for the use of ceramic laminates with minimally invasive preparations in order to obtain an esthetic result. Appropriate recommendation is directly related to successful treatment.

The Dumfahrt and Schaffer study⁹ had higher positive results in the follow-up period of 10 years, compared with other studies with shorter follow-up; however, analyzing the sample size used and the statistical test used, the validity of the study can be confirmed.

CONCLUSION

Based on the studies that were followed up for 2.5–10 years, one could suggest that the survival of the ceramic laminates with minimal preparation (with no preparation

or up to 1 mm) is satisfactory, which leads us to conclude that this technique has longevity.

More studies with similar methodologies should be encouraged to verify the results found here. Greater standardization of evaluation criteria as well as the correct selection of cases would facilitate the assessment of results.

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