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## Original article

# Evaluation of the effect of surface preparation using phosphoric acid and luting cement on the flexural strength of porcelain laminate veneering material



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## ABSTRACT

**Background:** Conventionally HF acid has been used for etching ceramic veneer restorations before their cementation. Studies are lacking regarding the effectiveness of phosphoric acid as a substitute for HF acid for etching the ceramic veneers. The purpose of this study was to evaluate the effectiveness of surface preparation of porcelain laminate veneers using phosphoric acid, as compared to HF acid etching in providing the necessary surface roughness conducive to development of an effective bond between the ceramic laminate and the resin luting cement.

**Methods:** 210 porcelain discs of 15 mm diameter and 0.9 mm thickness were prepared. These study samples were divided into seven groups of thirty samples each. Surfaces of the first (control) and the second group of samples were not prepared. The surfaces of other five groups were prepared with different surface treatments. Further all the groups of specimens were coated with a layer of resin luting cement. Flexural strength of each specimen was determined using universal testing machine and the results were compared. **Results:** The combination surface treatment using alumina surface abrasion followed by etching with phosphoric acid provided the highest flexural strength with the mean flexural strength of 101.11 MPa, followed by alumina surface abrasion (95.41 MPa), and phosphoric acid surface etching (81.68 MPa).

**Conclusion:** Laminate veneers surface treated using 50 µm alumina abrasion followed by etching with phosphoric acid showed the highest flexural strengths after resin coating compared to other groups.

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## Introduction

Porcelain laminate veneers have been used extensively and successfully to improve anterior tooth esthetics. The

popularity of these restorations is attributable to their esthetic quality, conservative preparation, fracture resistance, tissue acceptance, low debonding rate, patient satisfaction, and negligible incidence of caries.

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The clinical success of porcelain laminate veneer restorations is dependent on the intimate bond achieved between the restoration and tooth structure obtained via the resin cement.<sup>1</sup> The factors known to affect the effectiveness of resin/ceramic bond include the method of surface preparation using aluminum oxide surface abrasion<sup>2</sup> and etching with hydrofluoric acid.<sup>3</sup> These procedures create micro-irregularities on the porcelain surface, which help in providing a mechanical interlock with composite resin. This physical bond combines with the chemical bond obtained from the use of a silane coupling agent to provide a durable bonding effect between the etched porcelain and resin luting cement. Effective etching of the porcelain surface is considered to be an essential step for a successful restoration. Thus a study of morphologic patterns of etched porcelains, with various etchants, should yield information vital to the clinical success of etched porcelain bonded restorations.

The most commonly used etchant is 5% solution of hydrofluoric acid (HF acid). HF solution is considered to be hazardous to health and requires isolated workplaces with adequate ventilation. Studies regarding the efficiency of phosphoric acid as a viable alternative to etch ceramic are lacking.

Clinical failure of porcelain laminate veneer restorations is thought to be due to development of flaws on the surface of the restorations.<sup>4</sup> Surface imperfections act as a potential source of crack propagation which may be either inherent in the porcelain or introduced during the porcelain laminate veneer fabrication, surface treatment or cementation. Post-operative failure of the restoration also occurs as a consequence of thermal, mechanical and chemical variations that these restorations are likely to encounter in their service.<sup>5</sup> Further the resin cement used for luting the laminate veneer may impose surface changes on the veneer when subjected to thermocycling.

The purpose of this study is to evaluate the effectiveness of surface preparation of porcelain laminate veneers made up of

low-fusing feldspathic porcelain using phosphoric acid, as compared to HF acid etching and aluminum oxide surface abrasion in providing the necessary surface roughness conducive to development of an effective bond between the ceramic laminate and the resin luting cement.

## Materials and method

The materials and method followed in this study is as follows:

### Fabrication of ceramic disc specimen

About 0.6 g of Vitadur-alpha dentin powder was pre-weighed in an electronic balance and 0.22 ml of modeling fluid measured in micropipette. Ceramic powder was mixed with modeling fluid, placed in the custom made metallic mold and compacted. Discs were placed on the platinum sheet and then fired in Multimat vacuum furnace (Vita) according to manufacturer's instructions. 210 ceramic test specimens of 15 mm diameter and 0.9 mm thickness were fabricated.

### Grouping of the test specimens

The specimens were divided into seven groups of thirty specimens each (Fig. 1). They were designated as group A–G.

### Surface treatments of test specimens

The unglazed surface of specimen was surface treated as designated under:

1. **Group A (Control)** – no surface treatment.
2. **Group B** – no surface treatment, but the samples were thermocycled.
3. **Group C** – samples were surface treated using alumina abrasion by keeping them 2 cm away from the nozzle of the



Fig. 1 – Grouping of the ceramic samples into seven different groups.

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