

STUDY ON FILM THICKNESS OF FOUR RESIN CEMENTS

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- **ABSTRACT:** The purpose of this study was to determine and compare the film thickness of four resin cements, named Enforce (Caulk/Dentsply), Nexus (Kerr), Rely X (3M of Brazil) and Panavia 21 (Kuraray). The method was in compliance with American Dental Association Specification nº 8 for zinc phosphate cement. Statistical analysis was carried out using the Kruskal-Wallis test ($\alpha = 0.01$). The mean film thickness values (μm) of the four cements were: Enforce = 27.7; Nexus = 34.9; Rely X = 25.5 and Panavia 21 = 21.9. There was no statistical significant difference between the film thickness of Enforce and Rely X. The cements Panavia 21 and Rely X also demonstrated no statistical significant difference. Panavia 21 demonstrated the lowest and Nexus the highest film thickness values.
- **KEYWORDS:** Resin cements; film thickness.

Introduction

The demand for more esthetic restorations and the growing concern about mercury toxicity associated with dental amalgams have led to an increase in the use of resin composites and ceramic in posterior teeth.

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Dental luting agents provide the link between a fixed prosthesis and the supporting prepared tooth structure. Zinc phosphate cement has been the principal luting agent of choice for cementation of castings, becoming the most popular material, despite its well-documented disadvantages, particularly solubility and lack of adhesion.

Nevertheless, many alternative materials have been introduced and recently, resin cements have become popular, primarily because they have addressed the disadvantages of solubility and lack of adhesion. Glass ionomer cements are also popular, principally because these materials release fluoride that may prevent recurrent caries.

Many resin cements are manufactured specifically for the luting of inlays, onlays, crowns and bridges. Superior strength, reduced microleakage and increased retention have been reported for these type of cements.^{4,10,13}

The film thickness of the luting agent can directly affect long-term clinical success. In order to function as a successful luting agent, dental cements should not exhibit a very high film thickness. Low film thickness of the cement can improve seating and decrease marginal discrepancies, whereas improved marginal adaptation can also reduce plaque accumulation, periodontal disease and cement dissolution.¹⁵

According to American Dental Association¹ a maximum film thickness of 25 μm is allowed for a Type I cement, and 40 μm for a Type II.

The purpose of this study was to determine and compare the film thickness of four resin cements currently used in dental practice.

Material and method

The materials tested in this study were:

- Enforce – Caulk/Dentsply, Milford, Delaware, USA
- Nexus – Kerr, Stamford, USA
- Rely X – 3M of Brazil, Saint Paul, Minnesota, USA
- Panavia 21 – Kuraray, Okayama, Japan

The method used was in broad compliance with American Dental Association¹ Specification n^o 8 for zinc phosphate cement. Tests were conducted at room temperatures of 23°C and a relative humidity of 50%. Before testing, the investigator calibrated his techniques until uniformity was established. All materials were manipulated according to manufactures' instructions.

A portion (0.01 g) of the standard mix of cement was positioned between two flat round glass plates of uniform thickness, with a surface area of 2 cm². Identical plates were used in the same orientation for each measurement. Three minutes after mixing, a load of 15 kg was applied vertically to the plates. Ten minutes after mixing, the plates were cleaned with water and then acetone. Measurements were made with an electronic gauge to the nearest micron, with an accuracy of 0.5 µm, which was recalibrated after each recording. Each cement was measured ten times. The mean film thickness were calculated for each resin cement, and data statistically analysed (Kruskal-Wallis test).

Result

Table 1 displays the mean film thickness values (in microns) for each cement. The Kruskal-Wallis test at $\alpha = 0.01$ verified statistically similar resin cement groups that are different from other groups: there was no statistically significant difference between the film thickness of Enforce and Rely X, and between Panavia 21 and Rely X (Table 2).

Table 1 – Mean film thickness (in microns) for the four cements tested

Product	Mean
Enforce	27.7
Nexus	34.9
Rely X	25.5
Panavia 21	21.9

Table 2 – Kruskal-Wallis Test

Panavia 21	
Rely X	
Enforce	
Nexus	

Statistically similar groups, which are different from other groups, are linked by vertical lines.

Discussion

Considerable differences in the film thickness were found between the various resin cements. Several factors may influence the film thickness of a luting material. These include the substrate that the material is tested against,⁵ the size or shape of the filler, the viscosity of the unset material, and its rate of set.¹³

Panavia 21, Enforce and Rely X demonstrated mean film thickness of either less than 25 μm or very close to 25 μm , and can therefore be classified as Type I cementation agents according Specification nº 8 of the American Dental Association.¹ According to this specification, Type I materials are suitable for accurate seating of precision appliances. Nexus demonstrated mean film thickness of 34.9 μm , close to 40 μm , so that, can be classified as a Type II cementation agent. Type II resin-based materials, and some cements with even greater film thickness, are currently used routinely for cementation of fixed partial dentures. Laboratory procedures must be controlled to compensate for luting agents with high film thicknesses; one approach would be to lower the expansion ratios of intracoronal casting investments. Greater film thickness of die relief could also be used for the fabrication of extracoronal castings.^{2,3}

Leinfelder et al.⁵ have, from a theoretical point of view, suggested as a general rule that the interfacial gap should not exceed 100 μm , particularly on the occlusal surface, since wider gaps commonly may result in extensive wear of the composite resin luting agent. It must be recognized, however, that a thin film thickness, although an important factor, does not insure the seating of a casting. The internal adaptation of ceramic inlays is of importance since poorly fitting inlays are supported mainly by the luting cement rather than the tooth substance, which might influence the longevity of the restorations.

According to the clinical impression of Levine⁶ after bonding more than 600 resin-bonded, acid-etched restorations with many different resin cements, any resin cement with a film thickness of 40 μm or less shows no clinically perceptible occlusal discrepancy after the restoration is bonded in place.

Clinicians should be aware that the type of luting agent selected can directly affect film thickness. The metal type of the restoration, on the other hand, does not appear to be of clinically significant impact. However, the mixing technique has been shown to result in potentially clinically significant variation and is of greater influence than the metal type of the restoration being cemented.⁷

Different cements may require different cement spacing to ensure optimal seating.¹⁴ The resultant crown elevation is thought to be a function of

luting agent viscosity, which in itself is a time-dependent property that further increases with an increase in temperature.⁸

Resin cements have been shown to result in a significantly higher incidence of tilted castings, which demonstrated uneven cement thicknesses by comparison to zinc phosphate, glass ionomer or polycarboxylate cements,¹² presumably because of the higher viscosity of the resin. The clinical significance is, although a resin cement may be selected for its advantageous mechanical and adhesive advantages, its manipulation may bring, with it, an increased risk of incomplete seating of the restoration.

As film thickness increases, the tensile bond strength of cements to cast alloy decreases.⁶ Resin cements may be affected in this respect to a greater degree than are polycarboxylate cements. Film thickness is influenced by manipulative variables such as mixing temperature. Cold mixing significantly increases the film thickness of dual-cured resin luting agents.¹¹

Conclusion

- Panavia 21 demonstrated the lowest and Nexus the highest film thickness values;
- Enforce, Rely X and Panavia 21 can be used for cementation of all types of precision castings;
- Nexus can be used for most cementation procedures, with exception of precision attachments.

VARJÃO, F. M. et al. Estudo sobre espessura de película de quatro cimentos resinosos. *Rev. Odontol. UNESP (São Paulo)*, v.31, n.2, p.171-177, 2002.

- **RESUMO:** *O propósito deste estudo foi determinar e comparar a espessura de película de quatro cimentos resinosos, denominados Enforce (Caulk/Dentsply), Nexus (Kerr), Rely X (3M do Brasil) e Panavia 21 (Kuraray). O método utilizado foi baseado na Especificação nº 8 da American Dental Association para cimento fosfato de zinco. A análise estatística foi realizada utilizando-se o teste de Kruskal-Wallis ($\alpha = 0,01$). Os valores médios (em micrômetros) obtidos para a espessura de película dos quatro cimentos foram: Enforce = 27,7; Nexus = 34,9; Rely X = 25,5 e Panavia 21 = 21,9. Não houve diferença estatística entre os va-*

lores encontrados para Enforce e Rely X e entre Panavia 21 e Rely X. Panavia 21 demonstrou o menor e Nexus, o maior valor de espessura de película.

- PALAVRAS-CHAVE: Cimentos resinosos; espessura de película.

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