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Original Research

Comparative Evaluation of Tensile Bond Strength Of Two Different Luting Cements (Zinc Phosphate And Zinc Polycarboxylate) Used In Dentistry

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Abstract

Background: The objective is to compare the tensile bond strength of two different luting cements, specifically Zinc phosphate and Zinc polycarboxylate, utilized in dental applications.

Materials & methods: In the present study, one hundred freshly extracted maxillary first premolars were employed. All samples were meticulously cleaned and preserved in sterile saline for future use. Following the completion of cavity preparation, castings made from type IV dental stone were applied to each specimen. Wax patterns were utilized for the casting process. Subsequently, the castings underwent polishing, devesting, and finalization. The specimens were categorized into two research groups: Group A consisted of zinc phosphate, while Group B comprised zinc polycarboxylate. The mean tensile strength was determined using a universal testing machine. The results were analyzed using SPSS software and compiled into a Microsoft Excel spreadsheet. A Student's t-test was conducted to assess the significance of the findings.

Results: The specimens classified as Group A and Group B exhibited mean tensile strengths of 4.65 MPa and 3.28 MPa, respectively. Statistical analysis revealed significant differences in the mean tensile strength when comparing Group A to Group B.

Conclusion: The findings indicated that the average tensile strength of Zinc phosphate cement significantly exceeds that of Zinc polycarboxylate cement.

Key words: Dental cement, Tensile strength

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Introduction

For more than a hundred years, zinc phosphate cement has been a staple in dental practice. Its applications are diverse, encompassing the cementation of onlays as well as the luting of crowns and bridges.[1,2] This material belongs to the category of acid-base cements, characterized by an acidic component that consists of a phosphoric acid solution ranging from 45% to 65%, supplemented by zinc (up to 10%) and aluminum (1-3.1%). The presence of zinc and aluminum is essential in achieving the appropriate phosphate concentrations in the solution, which in turn modulates the reaction rate. This process results in an increase in the pH of the acidic solution, thereby diminishing its reactivity.[3] Set cements maintain a uniform phase throughout the setting process, as they do not experience phase separation; rather, water is incorporated within a specific chemical mixture. The concentration of phosphoric acid in the initial solution plays a vital role in determining the chemical and mechanical characteristics of the fully reacted cement. Therefore, it is essential to prevent the liquid component from gaining or losing water to the surrounding environment.[4,5]

This research was conducted to compare the tensile bond strength of two different types of luting cements, specifically zinc phosphate and zinc polycarboxylate, utilized in dental applications.

Materials and Methods

In the present study, one hundred freshly extracted maxillary first premolars were employed. All samples were meticulously cleaned and preserved in sterile saline for future use. Following the completion of cavity preparation, castings made from type IV dental stone were applied to each specimen. Wax patterns were utilized for the casting process. Subsequently, the castings underwent polishing, devesting, and finalization. The specimens were categorized into two research groups: Group A consisted of zinc phosphate, while Group B comprised zinc polycarboxylate. The mean tensile strength was determined using a universal testing machine. The results were analyzed using SPSS software and compiled into a Microsoft Excel spreadsheet. A Student's t-test was conducted to assess the significance of the findings.

Results

The specimens classified as Group A and Group B exhibited mean tensile strengths of 4.65 MPa and 3.28 MPa, respectively. Statistical analysis revealed significant differences in the mean tensile strength when comparing Group A to Group B.

Table 1: Mean tensile strength (MP A)

Groups	Mean tensile strength	p- value
Group A	4.65	0.0000*
Group B	3.28	

*: Significant

Discussion

Dental luting cements can be classified according to their application and chemical composition. Regardless of the specific material employed, it is essential that these cements demonstrate appropriate consistency and film thickness for effective cementation. Dental cements may be formulated from resin, water, or oil. Currently, there exists a variety of long-term and provisional cements, each differing in their chemical structure, properties, and clinical applications. Generally, temporary cements are categorized as either oil-based or oil-free.[6,7]

Historically, eugenol was a common ingredient in many of these cements; however, contemporary formulations are increasingly eugenol-free. When compared to water- and polymer-based cements, these alternatives tend to exhibit superior film thickness but inferior physical properties. It is crucial to ensure that the tooth is entirely devoid of any residual provisional cements prior to the application of final cements. The presence of oil can adversely affect the curing process of long-term cementation, thereby diminishing bond strength; consequently, there is a trend towards minimizing the use of oil in these formulations.[8,9]

In this study, the specimens classified as Group A and Group B exhibited mean tensile strengths of 4.65 MPa and 3.28 MPa, respectively. Statistical analysis revealed significant differences in the mean tensile strength when comparing Group A to Group B.

David R. Myers[10] and Garcia Godoy[11] indicated that there was no notable difference in the retention capabilities of zinc phosphate and polycarboxylate cements. In contrast, the current study demonstrated that zinc phosphate cement exhibited superior retentive strength compared to polycarboxylate cement, with this difference being statistically significant ($P < 0.05$). This discrepancy may be attributed to the mechanism of retention in zinc phosphate cement, which relies on mechanical interlocking and close physical adaptation to seal restorative margins, rather than forming any chemical bonds with tooth or metal surfaces.

Parameswari BD et al.[12] conducted a comparative analysis of the tensile bond strength (TBS) and marginal fit of complete veneer cast metal crowns utilizing various luting agents. The investigation was structured into four groups, each comprising 10 samples for the evaluation of TBS, alongside four additional groups with 5 samples each for the assessment of marginal fit associated with the selected luting agents. The findings were systematically organized and subjected to statistical analysis. The TBS of the luting cements, as well as the marginal fit in relation to these cements, were evaluated using appropriate testing apparatus. Specifically, the TBS was quantified using a universal testing machine, and the results were recorded. The marginal gap between the edge of the cast metal crown and the finish line was measured with a traveling microscope both prior to and following cementation. The variation between these measurements indicates the discrepancy attributable to the film thickness of the cement employed in the restoration process. Notably, the TBS values for zinc phosphate cement and glass ionomer cement were observed to be nearly identical.

Conclusion

The findings indicated that the average tensile strength of Zinc phosphate cement significantly exceeds that of Zinc polycarboxylate cement.

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